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PHYSICS AND MATHEMATICS

No. 69

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Physics and Mathematics

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ACOUSTICS

THERMAL DEFLECTION OF RADIATION IN ACOUSTOOPTICAL FREQUENCY SHIFT DEVICES

BOGOMOLOV, A. M. and MAGDICH, L. N.

[Abstract] The effect of a thermal field on the propagation of optical radiation
in a diffraction plane was investigated with respect to acoustooptical frequency
shift devices. A temperature gradient to which the refractive index gradient
corresponds forms in the acoustic line material along the z axis. The angular
deflection of the diffracted beam and the effectiveness of acoustooptical inter-
action are dependent on the control high-frequency power and increase as power
increases. Figures 2, references 5: 2 Russian, 3 Western.
[120-6521]

MEASUREMENT OF ULTRASONIC WAVES SCATTERED BY A SINGLE SCATTERER AND BY A GROUP
OF SCATTERERS, USING A RECEIVER OF FINITE DIMENSIONS

KOL'TSOVA, I. S., MIKHAYLOV, I. G. and ZHURBENKO, V. P.

[Abstract] Scattering of ultrasonic waves in a nonhomogeneous medium is considered
and the accuracy of their measurement with a receiver of finite but variable di-
mensions is analyzed on the basis of theoretical and experimental data. Theoreti-
cally the velocity potential of scattered waves and that of the resultant field
are found from the solution to the appropriate equations for a plane incident wave
and either the Dirichlet boundary conditions (perfectly "soft" scatterer) or
Von Neumann boundary condition (perfectly "rigid" scatterer), the scattered field
also satisfying the conditions of radiation at infinity. Experimentally the radia-
tion patterns were measured in a test cell containing a quartz radiator and a
quartz receiver, between them a single glass ball or a cluster of them "frozen" in

1

a 6% aqueous solution of gelatin with an acoustic impedance close to that of
water. Measurements were made with the quartz radiator excited at the funda-
mental frequency of 3 MHz and its odd harmonics within the 9-27 MHz range.
Increasing the receiver dimensions did significantly alter the recorded direc-
tional diagram with a single scatterer, increasing the instrument error and thus
the necessary correction, but not that with a cluster of scatterers. Figures 2;
references 6: 5 Russian, 1 Western.
[133-2415]

SCATTERING OF ACOUSTIC WAVES BY A THICK-WALLED ELASTIC CYLINDER

VEKSLER, N. and KORSUNSKIY, V., Institute of Cybernetics, ESSR Academy of Sciences

[Abstract] It is assumed that a thick-walled elastic circular cylinder of
infinite extent is located in an acoustic medium (an ideal compressible fluid).
An acoustic wave burst with planar front is incident on the cylinder parallel to
the longitudinal axis. The authors calculate the acoustic pressure field due to
scattering by the cylinder (the secondary field). The characteristics of this
field are correlated with the parameters of the wave burst and the thick-walled
cylinder. The zero of time is taken as the instant when the incident wave burst
touches the surface of the cylinder. The problem is reduced to solution of three
wave equations: one describing the motion of the acoustic medium, and the other
two describing the motion of the cylinder. Five conditions are assigned for con-
tact on the surface of the cylinder: three on the outer surface--continuity of
radial stresses and displacements and absence of tangential stresses; two on the
inner surface--absence of radial and tangential stresses. The solution is found
on the assumption that all unknown functions and their first derivatives with
respect to time are equal to zero at the initial instant, and that they are
bounded in the regions where they are defined. The structure of the frequency
and time dependences of the scattered field are studied. A method is proposed
for solving the inverse problem. Figures 4, references 20: 15 Russian,
5 Western.
[128-6610]

UNSTEADY SCATTERING OF ACOUSTIC WAVES BY AN ELASTIC CYLINDER WITH ELASTIC FILLER

VEKSLER, N. and KORSUNSKIY, V., Institute of Cybernetics, ESSR Academy of Sciences

[Abstract] It is assumed that a thick-walled elastic circular cylinder of infinite extent is located in an infinite acoustic medium. Inside the cylinder is a coaxial continuous elastic filler. A wave burst with planar front is incident on the cylinder parallel to the longitudinal axis. The authors calculate the unsteady acoustic pressure field due to scattering by the cylinder. The mathematical problem is reduced to solution of five wave equations, one describing the motion of the acoustic medium, two describing the motion of the cylinder, and two describing the motion of the filler. These equations are related by seven sets of contact conditions on the two cylindrical interfaces. On the interface between the acoustic and elastic media there are three conditions: continuity of radial displacements and stresses, absence of tangential stresses. On the interface between the two elastic media, four conditions are satisfied: continuity of radial and tangential displacements and stresses. Contact is total on this interface, the filler and cylinder are "welded" together. It is assumed that the unknown functions are bounded in the regions where they are defined. The zero of time is taken from the instant when the incident wave touches the cylinder; before this instant, the unknown functions and their first derivatives with respect to time are taken as equal to zero. Fourier transformation with respect to time is used in a method of separation of variables with respect to radial and angular coordinates. A method is proposed for solving the inverse problem. Figures 5, references 10: 5 Russian, 5 Western.
[128-6610]

ACCURACY OF DETERMINATION OF THE PARAMETERS OF SOURCES OF RANDOM ACOUSTIC SIGNALS BY A DIRECT RESOLUTION METHOD

ALEKSEYEV, V. I., GITEL'SON, V. S., GLEBOVA, G. M., KALENOV, Ye. N. and TIKHONRAVOV, V. N., Rostov State University

[Abstract] There has recently been an upsurge in interest in methods based on spectral analysis with the use of fast Fourier transforms and mutual correlation processing by channels when using antenna arrays for determining the parameters of random signals (coordinates and powers). Considerable difficulties arise in determination of signal parameters when the sources have close angular coordinates. In this paper, a method of direct resolution is proposed for estimating power and

angular coordinates of random signals sources by solving a system of nonlinear
equations obtained from expressions that relate signal parameters to the elements
of a spectral correlation matrix. Figures 6, references 3: 2 Russian, 1 Western.
[103-6610]

INVESTIGATION OF THE RELATION BETWEEN STRENGTH AND SIZE OF CAVITATION NUCLEI

BARABANOVA, G. Ya., IL'IN, V. P., LEVKOVSKIY, Yu. L. and CH⎯⎯V, A. V.

[Abstract] Experimental data are used to establish a relation between the
strength of cavitation nuclei and their sizes. It is shown that the strength
of the nuclei is two orders higher than the value calculated by the Blake
formula conventionally used for this purpose. It is suggested that the dis-
crepancy is due to a change in the capillary constant caused by surfactants
that are always present in water under real conditions. This hypothesis is
used as a basis in correcting the surface tension coefficients that appear in
the Blake formula, bringing the calculated values of strength of cavitation
nuclei into agreement with the measured values. Figures 4, references 10:
6 Russian, 4 Western.
[103-6610]

THEORY OF SCATTERING OF SOUND BY RANDOM INHOMOGENEITIES OF UNDERWATER GROUND

IVAKIN, A. N. and LYSANOV, Yu. P., Acoustics Institute imeni N. N. Andreyev,
USSR Academy of Sciences

[Abstract] The coefficient of backscattering of sound by the bottom in the
coastal regions of shallow seas is independent of the frequency of the sound
over a range of 1-100 kHz, and its angular dependence is close to Lommel-
Seelinger law for glancing angles of 5-50°: $m_s \sim \sin \chi$, where m_s is the coef-
ficient of backscattering, and χ is the glancing angle of the sound wave at the
bottom. The absolute values of m_s are about -30 dB at $\chi = 30°$. According to
a model previously suggested by Lysanov, the underwater ground is a nonreflective
layer of sediments with absorption, containing sharply anisotropic random inhomo-
geneities (fluctuations in the index of refraction) that are large-scale in the
horizontal plane and small-scale with respect to depth. In this paper the authors
show that the results found on the basis of this model are independent of the

specific form of correlation coefficient for the fluctuations in the index of refraction. Models with two or more scales are also developed. In these models the angular dependence of backscattering is given by $m_s = \sin \chi / \cos^3 \chi$, which agrees with experimental data. Figures 2, references 9 Russian.
[103-6610]

RESONANT SCATTERING OF A SURFACE RAYLEIGH WAVE FROM PERIODIC INHOMOGENEITIES ON THE BOUNDARY OF A SOLID

LAPIN, A. D., Acoustics Institute imeni N. N. Andreyev, USSR Academy of Sciences

[Abstract] In excitation and reception of Rayleigh surface waves by transducers in which the main component is a diffraction grating, the problem arises of resonant scattering as the wave propagates along a boundary with small periodic inhomogeneities. The author investigates the influence that quadratic resonant effects have on wave propagation along a boundary with small inhomogeneities in the form of an inertial load on the surface of a solid. The problem of multiple scattering of Rayleigh waves is solved by a modified theory of perturbations with consideration of terms of the second order of smallness with respect to the amplitude of inhomogeneities. The solid is taken as a half-space with a small inertial load having a surface density that is a periodic function of the longitudinal coordinate with zero average value. The acoustic field is found in this half-space with transition to a Rayleigh wave propagating along the longitudinal coordinate axis as the inertial load approaches zero. Figures 2, references 14: 10 Russian, 4 Western.
[103-6610]

TRANSIENT ENERGY EXCHANGE DURING INTERACTION OF TWO COHERENT LIGHT BEAMS IN ELECTROOPTICAL CRYSTALS

KUKHTAREV, N. V., MARKOV, V. B. and ODULOV, S. G., Institute of Physics,
Ukrainian SSR Academy of Sciences, Kiev

[Abstract] Transient energy exchange in lithium niobate crystals placed in an
external electric field was investigated and the theory which takes into account
both photovoltaic and diffusion-drift charge transfer in the crystal was developed
without regard to ordinary approximation of the given field with respect to the
pumping wave. Weak coherent light beams can be intensified by the effect of
transient energy exchange. A weak beam is always intensified as it approaches
the light beam intensity. The relative increase of intensity is quadratic as
external field intensity increases. The multiple of weak beam amplification is
not dependent on initial intensity or on the spatial frequency of the interference
field and images can be intensified several fold without nonlinear distortion.
Figures 7, references 19: 9 Russian, 10 Western.
[120-6521]

SHORTITE, A PROMISING MATERIAL FOR NONLINEAR OPTICS

MEYSNER, L. B.

[Abstract] Shortite (a double carbonate of sodium and calcium, $Na_2Ca_2C_3O_9$) was
investigated to determine lasing of the second harmonic from a garnet-neodymium
laser. Shortite displayed the effect of lasing on the second harmonic of laser
emission and phase synchronism was detected at 1064 nanometers. The phase
synchronism was established in shortite both by observing the intensive green
light of the second harmonic with the unaided eye and by the dependence of the

relative light intensity of the second harmonic on the average grain size in the sample. Shortite is related to group B of the Kurtz-Perry classification, but is not hygroscopic and is a harder material than KH_2PO_4. Figures 1; references 5: 3 Russian, 2 Western.
[121-6521]

ULTRASONIC INJECTION OF CHARGE CARRIERS FROM A METAL-PIEZOELECTRIC CONTACT

OSTROVSKIY, I. V., Kiev State University imeni T. G. Shevchenko

[Abstract] A piezoactive ultrasonic wave propagating in a bounded medium is accompanied by piezoelectric fields both parallel and normal to the direction of propagation. The amplitude of these fields can run to tens of kV/cm. In the case of a metallized waveguide surface, the piezoelectric field component normal to the surface does not vanish. Therefore the passage of a piezoactive elastic wave through the region of a metal-piezoelectric contact is equivalent to the application of an electric field to the contact. A consequence of this should be the injection of charge carriers from the metal into the piezoelectric material. This is observed experimentally at 77.4 K with a single crystal CdS specimen grown from the vapor phase; the specimen was 9.8 mm long, 1.09 mm wide and 170 micrometers thick with hexagonal axis C_6 directed lengthwise. A system of In-Ga electrodes was applied to the specimen. A 5.2 MHz signal was fed to a pair of driving electrodes, which excited the first antisymmetric Lamb mode. The resistance was measured between a pair of contacts 2 mm long, which is greater than the ultrasonic wavelength. The resistance is plotted as a function of the exciting voltage (between 10 and 80 volts) to illustrate the rise in charge carrier concentration. The slope of the line is 1.02 in a range of 10 to 45 volts; at the break point of 45 volts, the slope changes abruptly and is approximately $R^{-1} = v3.55$. It is suggested that ultrasonic injection is a possible technique for studying the properties of metal-dielectric contacts, as well as with practical applications to the design of new acoustical-electronic signal storage and processing devices. Figures 1; references 7: 3 Russian, 4 Western.

THEORY OF PROPAGATION OF AN ELECTROMAGNETIC WAVE AND AN ACOUSTIC WAVE IN A
CHOLESTERIC LIQUID CRYSTAL

IOFFE, I. V., All-Union Scientific Research Technological Institute of Antibiotics
and Enzymes for Medical Purposes

[Abstract] A theoretical analysis is made of the propagation of electromagnetic
and acoustic waves in dielectric and conductive cholesteric crystals, and it is
shown that additional waves arise when the incident waves propagate across the
cholesteric axis. These are surface waves up to certain wave frequencies. In a
conductive layer of cholesteric liquid crystal, the additional wave may oscillate
repeatedly with simultaneous damping. The amplitudes of the waves are determined.
It is shown that the acoustic wave may generate an electromagnetic field, and that
it may become unstable in an external field. An examination is made of the forma-
tion of an acoustoelectric field and an associated acoustomagnetic field. It is
shown that Alfven waves also have an additional branch in a conductive cholesteric
liquid crystal. References 5: 4 Russian, 1 Western.
[134-6610]

RADIATION EFFECTS IN SEMICONDUCTORS AT LOW DOSES OF PARTICLE BOMBARDMENT

BOLOTOV, V. V., KOROTCHENKO, V. A., MAMONTOV, A. P., RZHANOV, A. V., SMIRNOV, L. S.
and SHAYMEYEV, S. S., Institute of Physics of Semiconductors, Siberian Department,
USSR Academy of Sciences, Novosibirsk

[Abstract] An investigation is made of the behavior of silicon parameters with
exposure to low doses of electrons and Co-60 gamma quanta. The analysis is based
on measurement of the lifetime of nonequilibrium charge carriers by studying
transient processes of resistance recovery in the base of junction-alloy diodes
following a current pulse in the forward direction, and also on silicon and
gallium arsenide specimens using methods of photoconductivity and the photo-
magnetic effect. The specimens were irradiated by 3.5 MeV electrons with average
current density of about 0.01 $\mu A/cm^2$ at 20°C, and annealed at 250°C in air. The
intensity of gamma quantum radiation was about $2 \cdot 10^{11}$ quanta/$cm^2 \cdot s$ at 20°C. It
was found that carrier lifetime increases by a factor of 2-4 up to electron doses
of $(1-2) \cdot 10^{12}$ cm^{-2}, and then begins to fall off at doses above $3 \cdot 10^{12}$ cm^{-2}. An-
nealing revealed that the effect is stable up to 250°C. The results show that the
increase in lifetime is not due to a change in surface state. Low-dose gamma
bombardment showed a similar pattern of increasing carrier lifetime. The effect
is attributed to two processes: a reduction in the number of recombination-
active centers of chemical nature (Au, Cu and so on) causing an increase in

lifetime; a reduction in carrier lifetime due to an increase with dose in the number of radiation-induced recombination centers, and reverse dissolution of the active dopant in nonequilibrium vacancies. If this interpretation is valid, it should be possible to detect changes in other parameters of crystals on the initial stages of irradiation that are later masked by the influence of increasing numbers of radiation-induced defects. Figures 2, references 9: 7 Russian, 2 Western.
[161-6610]

INFLUENCE OF RE-RADIATION EFFECT ON ELECTROLUMINESCENCE KINETICS

ROSSIN, V. V. and SIDOROV, V. G., Leningrad Polytechnical Institute imeni M. I. Kalinin

[Abstract] A rigorous quantitative approach is proposed to analysis of the kinetics of luminescence in variband structures with consideration of the effect of re-radiation. It is shown that the time constant of rise in luminescence and the speed of a light-emitting diode is greater than the lifetime of nonequilibrium charge carriers, and is equal to $\dfrac{\tau}{1 - (\beta/u^*)}$, where τ is the lifetime of electrons in the p-region, β is the internal quantum efficiency, $u^* = N/\sqrt{N^2 - 1}$, and N is the index of refraction. At β not much greater than unity, this is the non-radiative lifetime. References 7: 5 Russian, 2 Western.
[151-6610]

INFLUENCE THAT LOCALIZED STATES IN A SEMICONDUCTOR LAYER OF CRITICAL THICKNESS HAVE ON THE ELECTROPHYSICAL PROPERTIES OF THIN-FILM MS'DS STRUCTURES

SYNOROV, V. F., BEZRYADIN, N. N., SYSOYEV, B. I. and MARTYNOVA, N. A., Voronezh State University imeni the Lenin Komsomol

[Abstract] An analysis is made of localized states in a layer of a wide-band semiconductor S' and in the S'D interface and their influence on the electrostatic characteristics of MS'DS structures. The work is based on measurement of the current-voltage and r-f capacitance-voltage characteristics of Ga_2Se_3

layers in an Me-Ga$_2$Se-Si structure. The way that the surface potentials in the semiconductor substrate and in the S' layer on the S'D interface depend on the external voltage applied to the structure is determined by numerical solution of the Poisson equation sequentially for the S' layer, the D layer and the space-charge region in the S layer. A model of the MS'DS structure is proposed with localized states in the semiconductor layer and on the S'D interface that explains the experimentally observed features of the capacitance-voltage curves of aniso-tropic Al-Ga$_2$Se$_3$-Si structures with p-silicon. Analysis of the capacitance-voltage and current-voltage characteristics shows that donor centers in thin layers of Ga$_2$Se$_3$ occur at a depth of about 0.72 eV with concentration of about $5 \cdot 10^{16}$ cm^{-3}. The majority carriers are electrons with concentration of about 10^{12} cm^{-3}. Figures 4, references 12: 9 Russian, 3 Western.
[152-6610]

ELECTRICITY AND MAGNETISM

PROPAGATION OF A CONTINUOUS ELECTRON BEAM IN AIR

ARTAMANOV, A. S., GORBUNOV, V. A., KUKSANOV, N. K. and SALIMOV, R. A., Novosibirsk

[Abstract] Experiments are done on the propagation of electron beams in a gas. The radial distribution of beam current density was measured by densitometry on an exposed film, and by using a graphite collector. The measurements were done in the magnetic field of a solenoid, and with propagation in field-free space. Beam dimensions were measured after rotation by a magnetic field. The experimental electron beams had energies of 1.2 and 1.4 MeV and current up to 20 mA (power up to 28 kW), and were coupled into the atmosphere with a radius of 1.5 mm. The results show that a magnetic field is an effective means of reducing the broadening of an electron beam due to scattering in air. A transverse electric field is effective for turning and deflecting electron beams. The effectiveness of a longitudinal field is increased due to heating of air for currents of tens of mA. Figures 6, references 5: 4 Russian, 1 Western.
[125-6610]

SOME PARTICULARS OF THE ENERGY SPECTRA OF FLUCTUATIONS IN THE AMPLITUDE AND ANGLES OF ARRIVAL OF CENTIMETER AND MILLIMETER RADIO WAVES PROPAGATING ABOVE THE SEA

LOBKOVA, L. M., MISHAREVA, N. I., LUK'YANCHUK, A. G., NADOBENKO, A. I., POPOV, V. P, ZHURAVLEV, V. P., DUSHENKO, A. V., STEL'MAKH, V. V. and BERKHINA, L. I., Sevastopol' Instrument Building Institute

[Abstract] An experimental study is done on the characteristics of signals on wavelengths of 3.2 cm and 8.6 mm propagating over the surface of the sea over a 9.6 km transmission path at a minimum distance of 250-300 m from the shore. The

experiments were done with vertical polarization at different heights of the sending and receiving antennas. The energy spectra of fluctuations of amplitude and angles of arrival were calculated by Fourier transformation of the correlation function of the random process. It was found that most of the fluctuation energy is concentrated in a region no wider than 1 Hz. The spectra frequently showed several maxima, and the frequency dependence of spectral density on the falling section of the curve in most cases was approximated by a power function of the form $G \cdot f^{-n}$. Values of n were 2.60 and 2.57 on a wavelength of 3.2 cm for fluctuations in amplitude and angles of arrival respectively, and the corresponding values of n were 2.21 and 2.47 for a wavelength of 8.6 mm. The results of the experiments who that the signal is affected by the condition of the surface of the sea, and by the state of the air layer near the water: in calm weather, signal fluctuations are determined mainly by the state of the air layer in warm months and mainly by the condition of the surface of the sea in cold months; in rough weather, the influence of the atmosphere is felt up to frequencies of 0.05 Hz, and the agitation of the sea becomes predominant at frequencies near 0.2 Hz. Figures 2, references 15: 11 Russian, 4 Western.
[135-6610]

NOISES OF PHASED ANTENNA ARRAYS

ZAYTSEV, E. F., DIKIY, V. N. and BABENKO, A. I., Leningrad Polytechnical Institute

[Abstract] The output noises and sensitivity of passive and active scanning antenna arrays are determined when the radiators interact. A phased reception antenna array with parallel summation is considered in a system that contains radiators, amplifiers and a distribution device that consists of an adder and phase shifters. The wave parameters of the devices in the array are used as a basis in analyzing noise interference in the channels. It is shown that the noise of the various sources (amplifiers, phase shifters, adder and so on) may be correlated. The level of the output noises of the antenna depends on its phasing, and varies during scanning, while the sensitivity (signal-to-noise level at the output) varies with beam deflection differently from simple amplification. Simple relations are derived that show how this variation depends on the effective reflectivity determined in the transmission mode with excitation of all radiators. This parameter can be used alone for fairly accurate accounting for the influence of radiator interaction on the noise properties of passive and active phased antenna arrays. The sensitivity can be made less sensitive to scanning angle by optimizing the parameters of the input circuits in active arrays. Figures 2, references 10: 7 Russian, 3 Western.
[135-6610]

UDC 537.521

INVESTIGATION OF THE REDISTRIBUTION OF CURRENT IN A NANOSECOND VOLUMETRIC
DISCHARGE AFTER ARISAL OF A CATHODE SPOT

KUZ'MIN, V. A. and ROTSHTEYN, V. P., Tomsk Pedagogical Institute
imeni the Lenin Komsomol

[Abstract] In breakdown of strongly overstressed gaps in the case of uniform
initiation of initial electrons, there is a quasistable glow discharge stage
with a duration of a few tens of nanoseconds. It has been shown in previous
research that contraction of such a discharge is initiated by a micro-explosion
on the cathode and formation of a cathode spot. After the cathode spot has
formed, a diffuse channel is observed with subsequent growth of a highly conduc-
tive spark channel. The authors study the redistribution of current in the
volumetric discharge by using a technique developed specially for the purpose
of recording the current through the cathode spot. A pulsed discharge was
ignited in air at a pressure of 76 mm Hg between cylindrical electrodes 2 cm
in diameter with gap length of 0.7 cm. The electrodes were shaped so as to set
up a nearly uniform electric field in the gap. A two-channel oscillator was
used to initiate a UV background in the main gap by a 15 ns pulse, followed by
a pulse from the second channel with duration that could be varied from 20 to
200 ns. This produced a discharge on an area of 0.6 cm^2 with average current
density of 500 A/cm^2 and average electron concentration of 10^{14} cm^{-3}. The
specially designed cathode for measuring current redistribution used a Rogowski
loop for registration of the current from a small section of the cathode surface.
It was found that a highly conductive channel is produced above the cathode spot
when the current density in the diffuse channel reaches $(1-3) \cdot 10^5$ A/cm^2. The
mechanism of channel formation is assumed to be associated with distortion of
the electric field in the discharge column and intensified impact ionization in
the distorted field. The energy release in the diffuse channel produced by cur-
rent redistribution completes the contraction process. Figures 5, references
4 Russian.
[152-6610]

FLUID DYNAMICS

RELAXATION EFFECTS IN PROPAGATION OF WEAK SHOCK WAVES IN THE OCEAN

GOL'DBERG, V. N., ZARNITSYNA, I. G., FEDOSEYEVA, T. N. and FRIDMAN, V. Ye.,
Scientific Research Institute of Radio Physics

[Abstract] The principal parameters of shock waves in the ocean that are caused
by explosive sources of sound are comparatively well described by relations of
nonlinear acoustics. However, the duration of a shock wave increases during
propagation more rapidly than predicted by nonlinear acoustics. One cause for
this may be the influence of dissipative and relaxation effects due to molecular
viscosity and dissolved salts. In this paper a numerical analysis is made of the
combined action of nonlinearity, dissipation and relaxation, using an equation for
a spherical wave in a homogeneous, dissipative and relaxing medium. This is a
modified Burgers equation in which the spherical divergence of the wave is shown
by an exponential increase in the coefficients of viscosity and relaxation. The
authors thank O. V. Rudenko for discussing the work and for constructive comments.
Figures 7, references 9: 3 Russian, 6 Western.
[103-6610]

ENERGY TRANSFER AND TURBULENCE SPECTRA UPON EXCITATION OF A GRADIENT INSTABILITY
IN THE IONOSPHERIC PLASMA

MOISEYEV, S. S., SAGDEYEV, R. Z., TUR, A. V. and YANOVSKIY, V. V., Khar'kov
Physicotechnical Institute, UkSSR Academy of Sciences

[Abstract] Turbulence arises in a fluid or plasma as a system with many degrees
of freedom tends to rid itself as rapidly as possible of nonequilibrium states.
In an incompressible liquid this leads to excitation of a large number of degrees
of freedom and to a Kolmogorov cascade in the turbulence spectrum with constant
energy flow. In this paper the authors consider an example in which plasma

turbulence differs from the hydrodynamic scheme of Kolmogorov energy transfer: turbulence of drift waves with unmagnetized ions. It is shown that the mechanism of energy transfer in this type of turbulence is somewhat similar to spontaneous violation of symmetry in field theory. Due to instability, violation of initial symmetry is advantageous to the system, and subsequently conditions are brought about for more rapid transfer of energy to the dissipation region. As a basis for experimental comparison, the theoretical analysis applies to the ionospheric plasma at an altitude of hundreds of kilometers in the equatorial region where drift turbulence covers wavelengths from a few meters to hundreds of meters. The source of the nonequilibrium is a vertical gradient in density of the ionosphere. The principal equations are derived on the basis of two-fluid plasma hydrodynamics, assuming an electrostatic field with equal densities of isothermal electrons and ions. The inertia of the electrons and ions is disregarded. It is shown that the primary drift wave propagating transversely with respect to the magnetic field of the earth gives rise to a secondary wave that propagates vertically. The primary wave is subjected to "self-stress" via the secondary wave, and the resultant non-linear interaction of the waves results in energy transfer. The k^{-3} turbulence spectrum is found. Figures 2, references 11: 3 Russian, 8 Western.
[110-6610]

ROLE OF SOLUTIONS IN STRONG TURBULENCE

KRYLOV, S. F. and YAN'KOV, V. V., Institute of Atomic Energy imeni I. V. Kurchatov

[Abstract] It is shown why particular solutions in the form of solitons play such an important part in strong turbulence. In a number of situations the behavior of strong turbulence can be described by dissociation into a weakly non-linear spectrum and solitons. The dispersion of waves that have soliton solutions is usually such that energy transfer into regions of short wavelengths is impeded, and the wave system is able to evolve for a considerable time without dampling out, arriving at a state of thermodynamic equilibrium characterized by collective temperature, and a spectrum may result that is in equilibrium with the solitons. In this picture, the solitons play the part of droplets of liquid phase, and the coupling energy of waves in the soliton plays the part of heat of vaporization. Thermodynamic equilibrium in this case applies only to wave degrees of freedom. The waves are not in equilibrium with the medium. The authors find the parameters of a weakly turbulent spectrum in equilibrium with a soliton of given amplitude for near-sonic waves. An example is given of a system that permits soliton solutions without phase separation in turbulence in the Rudakov-Tsytovich equation. In general, equilibrium is not possible where there is rapid fractionation of scales, as in the case of an ideal fluid or three-dimensional Langmuir waves, or if interaction is completely prevented by some transformation of the system. The authors thank L. I. Rudakov for constructive criticism regarding behavior of solutions of one of the equations. Figure 1, references 7 Russian.
[111-6610]

NONLINEAR REFRACTION OF SOLITONS

SHRIRA, V. I., Institute of Oceanology imeni P. P. Sharshov, USSR Academy of Sciences

[Abstract] A general solution is found for the system of equations

$$\theta'_\beta - \Delta'_\alpha/V = 0, \quad \theta'_\alpha + V\Delta'_\beta/\Delta = 0$$

in the orthogonal system of coordinates α, β formed by the sequential positions of the front of a soliton (α = const) and the normals to the soliton (β = const). These equations relate the local velocity V of the soliton to the angle of inclination to the x-axis, where Δ is the width of the tube of rays, and $W_c\Delta$ = const, where W_c is the total energy per unit of length of the soliton front. The system is solved for media with weak nonlinearity of arbitrary type. These general solutions describe self-refraction, and in particular self-focusing of solitons in media with arbitrary laws of nonlinearity and dispersion. The author discusses the asymptotic behavior of solitons beyond the limits of the adiabatic approximation. Thanks are expressed to L. A. Ostrovskiy and Ye. N. Pelinovskiy for constructive discussions and interest in the work, and to V. Ye. Zakharov for discussing the results. Figures 4, references 14: 8 Russian, 6 Western. [111-6610]

NOISE CHARACTERISTICS OF THE METHANE RESONANCE OF A HELIUM-NEON-METHANE RING LASER

NIKOLAYENKO, A. N., Khai'kov State Scientific Research Institute of Metrology

[Abstract] The methane resonance of a gas ring laser occurring in a weak zone was investigated with respect to the fact that the stability of laser emission frequency is directly proportional to the signal-noise ratio. The resonance peak in a two-wave mode reveals output considerably higher than that in a single-wave mode. The noise characteristic of methane resonance of a helium-neon-methane ring laser increases as amplitude increases. Figure 1, references 5: 4 Russian, 1 Western.
[120-6521]

NONLINEAR SPLITTING OF LONGITUDINAL VIBRATIONS IN A LASER WITH DISTRIBUTED LOSSES

GUDKOV, Yu. P.

[Abstract] Field vibrations with different spatial structure were investigated to determine the nature of the stability of these vibrations. The vibrational stability must be investigated for detailed study of the coordinate field dependence. The approximate values of field amplitudes in the case of high reflection coefficients on the boundaries of the medium were found. Field distribution during lasing in a laser with high amplification factor and low distributed losses was calculated with respect to weak spatial inhomogeneity. This field distribution is of different value and is determined by the thickness of the amplifying layer if there are low losses in the cavity mirrors. A series of differential

equations is derived to determine the stability of field generation with given spatial distribution and to find the range of values of the indices that determine field generation stability. Figures 2; references: 7 Russian.
[121-6521]

EXCIPLEX LASERS

GUDZENKO, L. I., LAKOBA, I. S. and YAKOVLENKO, S. I.

[Abstract] The article is a survey of the literature on problems of lasers based on electron transitions of diatomic exciplex molecules. An analysis is made of the optical characteristics of lasing transitions in such molecules with consideration of factors that influence gain in bound-bound and bound-free transitions. Tables are given summarizing the parameters of excimer and exciplex lasers based on molecules of Xe_2, Kr_2, Ar_2, He_2, Hg_2, XeF, KrF, ArF, XeCl, KrCl, ArCl, XeBr, KrBr, XeO, KrO, ArO, HgCl and HgBr, and an explanation is given of experimental conditions of lasing on these molecules: pumping conditions, active medium, energy and time characteristics and temperature dependence of stimulated emission. The mechanisms of population of working levels are discussed. Requirements of a general nature are given for prediction of exciplexes that can be expected to lase: a working transition corresponding to a large cross section of induced radiation; a thermally stable upper working state; a rapid mechanisms for depopulation of the lower working state; feasibility of a working medium that is dense and comparatively transparent to the amplified radiation. The monohydrides of inert gases (HeH, NeH, ArH, KrH) are singled out as particularly interesting exciplexes with parameters that meet requirements for lasing. Figure 1, references 175: 43 Russian, 1 Czech, 131 Western.
[127-6610]

UP-CONVERSION OF NEODYMIUM LASER EMISSION TO THE VISIBLE REGION OF THE SPECTRUM IN RUBIDIUM VAPOR

ARKHIPKIN, V. G., MAKAROV, N. P., POPOV, A. K., TIMOFEYEV, V. P. and EPSHTEYN, V. Sh.

[Abstract] Garnet neodymium laser output on 1.06 μm is converted to visible emission in the blue region on 420 nm in rubidium vapor by two-photon resonance

of the pumping frequency with transition 5s-16d. The emission frequency of the neodymium laser was doubled in a lithium niobate crystal and separated from the second harmonic by a dispersion prism. Emission on the doubled frequency was used for pumping a rhodamine-B dye laser emitting on 604 nm. A mirror system was used for mixing the first harmonic with the dye laser output in rubidium vapor, with lenses matching the wavefronts of the interacting beams. Emission on 420 nm was isolated by a monochromator and recorded by a photomultiplier and oscilloscope. The power conversion factor was 0.1% for a 700 W input signal. Figure 1, references 4: 2 Russian, 2 Western.
[157-6610]

REACTOR LASER BASED ON A MIXTURE OF XENON WITH URANIUM HEXAFLUORIDE

GUDZENKO, L. I., LAKOBA, I. S., SLESAREV, I. S. and YAKOVLENKO, S. I.

[Abstract] The authors discuss the concept of using monofluorides of inert gases as the laser-active component of a reactor laser: a facility in which the energy of fission fragments of gaseous nuclear fuel (UF_6) is converted to coherent emission. A first-approximation analysis is made of the "reactor" and "laser" parts of the problem of developing a reactor laser based on a mixture of $Xe + UF_6$. The possibilities for relaxing requirements on nuclear pumping are discussed. The threshold power per unit of working volume for lasing is estimated, assuming initial conditions of self-excitation: $\kappa^+ - \kappa^- > \zeta/L$, where $\kappa^+ = \sigma^+ M$ is the gain on transition $B \rightarrow X$, σ^+ is the phototransition cross section, M is the concentration of the exciplex $XeF(B^2\Sigma)$, $\kappa^- = \sigma^- N_{UF_6}$ is the coefficient of absorption of the working radiation by uranium hexafluoride, σ^- is the photoabsorption cross section, N_{UF_6} is the concentration of UF_6, ζ is the coefficient of radiation losses in the optical cavity of length L. It is shown that this threshold factor increases faster than linearly with increasing N_{UF_6}. An analysis is made of the compatibility of constraints imposed on N_{UF_6} and threshold lasing power by the kinetic scheme of population of XeF* on the one hand, and the energy characteristics of the nuclear reaction on the other hand. It is shown that the NF_6 concentration can be reduced by using a solid moderator. Steady-state and pulsed modifications of the reactor laser are discussed. It is pointed out that more information is needed on the possible chemical reactions of particles in the plasma. This will require research on the formation of exciplexes XeF*, measurement of the corresponding kinetic coefficients and optimization of the working gas mixture. Figure 1, references 34 .
[127-6610]

PLASMA LASER WITH CONVECTIVE CIRCULATION

GUDZENKO, L. I., BABENKO, S. M., PLESHANOV, A. S. and YAKOVLENKO, S. I.

[Abstract] An investigation is made of the problem of effective heat removal in
plasma laser facilities. Systems with a large volume of the active zone and cor-
respondingly low specific power of input energy are considered. The authors
study the question of whether convective circulation can remove enough heat to
maintain a sufficiently low gas temperature while keeping the threshold power per
unit of working volume at a high level so that stimulated emission does not re-
quire an excessively long active zone. The analysis applies to the kinetics of
a plasma produced by charged hard particles in dense helium with strontium addi-
tive. Calculations show that convective circulation can provide the necessary
heat removal even at specific power levels that considerably exceed the threshold
values required for lasing. Figures 5, references 14: 10 Russian, 1 Czech,
3 Western.
[127-6610]

CONVERSION OF SOLAR RADIATION TO LASER EMISSION ON A MIXTURE OF Xe + Cs

GUDZENKO, L. I., GOLGER, A. L. and YAKOVLENKO, S. I.

[Abstract] An analysis is made of the feasibility of making a facility in which
solar radiation is converted with appreciable efficiency directly to laser emis-
sion. A laser arrangement based on a mixture of xenon with cesium vapor is con-
sidered in which lasing can be realized on the electron transition $Cs(7P) \to Cs(5D)$.
The processes that fill the upper lasing level are $Cs(6S) + Xe + h\nu \to Cs(7P)Xe$ and
$Cs(7P)Xe + Xe \to Cs(7P) + 2Xe$. Depopulation of the lower level is due to the
process $Cs(5D) + Cs(6S) \to Cs(6P) + Cs(6S)$. It is shown that the proposed scheme
for population inversion with solar pumping could in principle produce laser radia-
tion on a wavelength of $\lambda = 13,800$ Å with efficiency $\eta = 0.6\%$. The final solution
of the question of a realistic pumping process awaits a detailed investigation of
rates of collisional transitions between the excited states of Cs. Figures 2,
references 12: 5 Russian, 7 Western.
[127-6610]

UDC 621.382.2.535.376

OUTLOOK FOR MAKING LONG-WAVE HETEROSTRUCTURE LASERS BASED ON AgInPAs SOLID SOLUTIONS

ISMAILOV, I., Physicotechnical Institute imeni S. U. Umarov, TaSSR Academy of Sciences

[Abstract] An examination is made of the feasibility of using heterojunctions based on solid solutions of InPAs/GaInPAs and InPAs/GaInAs to make efficient room-temperature lasers and light-emitting diodes in the wavelength range of 1.7-2.6 μm. It is shown that heterojunctions $InP_{1-z}As_z/Ga_xIn_{1-x}As$ with x close to 0.16 and z close to 0.67 can be used to make lasers and LEDs that emit close to 2.6 μm at 300 K. Compositions are given for melts for growing epitaxial layers of double heterostructures based on $Ga_xIn_{1-x}P_{1-y}As_y$ on a substrate of $P_{1-z}As_z$ (where z is close to 0.27) at a temperature of 680°C for lasers and LEDs emitting on 2 μm. Figure 1, references 5: 3 Russian, 2 Western.
[129-6610]

GAIN IN A COMPTON LASER

ZARETSKIY, D. F., NERSESOV, E. A. and FEDOROV, M. V., Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences

[Abstract] An examination is made of amplification in the Compton laser first proposed by Pantell et al. [see R. H. Pantell, J. Sonciny, H. E. Panthoff, IEEE, J. QUANT. ELECTR., Vol QE-4, 1968, p 905]. In this device an electron beam interacts with the field of two external electromagnetic waves: the pumping wave and the wave to be amplified. An expression is found for the gain in a noncollinear arrangement of propagation of the waves and the electron beam, and it is shown that for a comparatively large scatter of electron energies in the beam the use of a non-one-dimensional system is actually advisable. In the optimum configuration, the pumping wave propagates in the direction opposite to that of the electron beam, and the wave to be amplified propagates at some fairly small angle to the direction of the electron velocity. The optimum angle is found that maximizes gain, and estimates are made of the corresponding gain for lasing conditions that are feasible at present. It is shown that appreciable gain can be realized in the ultraviolet range with pumping by a CO_2 laser. Figures 2, references 19: 13 Russian, 1 Hungarian, 5 Western.
[134-6610]

MEASURING THE RATIO OF EMISSION WAVELENGTHS OF LASERS STABILIZED WITH RESPECT
TO SATURATED ABSORPTION IN IODINE AND METHANE

KAPRALOV, V. P., MALYSHEV, G. M., PAVLOV, P. A., PRIVALOV, V. Ye.,
FOFANOV, Ya. A. and ETSIN, I. Sh.

[Abstract] One of the main problems in making a unified time-length standard is
measurement of frequency or wavelength ratios of laser emission in the visible
and near infrared. The authors describe an interference facility for measuring
laser wavelength based on stabilizing the length of optical cavities and optical
heterodyning. Results of measurement of wavelength ratios are given for lasers
with methane and iodine cells. The measured ratio for wavelengths of $He-Ne/CH_4$
and $He-Ne/^{127}I_2$ (peak "d") lasers was $5.35905003\underline{+}0.000000019$ (0.95). A table
is given summarizing the sources of error in the measurements. The authors thank
V. M. Tatarenkov for furnishing the $He-Ne/CH_4$ laser, V. V. Kuchinskiy for consulta-
tion on the theory of a nonideal Fabry-Perot interferometer, M. A. Furman and
N. F. Makarov for designing and making dielectric coatings, and A. V. Zlobin and
G. I. Leybengardt for taking part in the measurements. Figures 1, references 16:
13 Russian, 3 Western.
[104-6610]

EXCITATION OF A GAMMA LASER BY THE NUCLEAR RAMAN EFFECT

ISHKHANOV, B. S. and PISKAREV, I. M., Scientific Research Institute of Nuclear
Physics, Moscow State University

[Abstract] The reaction of radiative capture of neutrons and synchrotron radiation
have been suggested for pumping gamma lasers on nuclear transitions. In this paper
the authors consider a version of gamma laser pumping by the nuclear Raman effect,
which consists in excitation of lower levels of a target nucleus upon inelastic
scattering of gamma quanta in the region of giant dipole resonance. The effect is
due to tensor deformation of the nucleus, and should be observed in all aspherical
nuclei. A three-level scheme is proposed for laser pumping by this mechanism with
low spectral density of pumping radiation. A minimum number of 10^{15} excited
nuclei must be available to achieve lasing. Target nuclei with lifetimes of ex-
cited states in the range of 0.1-10 s can be used. The required pumping parameters
can be realized on available electron accelerators with energy of 30 MeV and beam
current of 0.5 A. Figure 1, references 7: 4 Russian, 3 Western.
[109-6610]

HIGHLY STABLE LASER SYSTEM WITH CONTROLLABLE PULSE DURATION FROM 100 ps TO 10 ns

MEDVEDEV, S. K., PETROV, V. F. and STARTSEV, V. R.

[Abstract] Sometimes lasers are needed with pulse duration that can be continuously varied from tens of picoseconds to a few nanoseconds, and with time and energy characteristics that are stable from flash to flash. Methods of self-mode locking and forced mode locking cannot completely meet either requirements for stability of parameters or capability for continuous control of pulse duration. In this paper the authors suggest a new, fairly simple and reliable method of producing subnanosecond light pulses that are stable with respect to energy and duration, and have high contrast. The technique is based on using an electro-optical deflector to cut a short pulse out of a monopulse. The deflector is made of a monodomain crystal of lithium niobate. A quadrupole capacitor for producing an inhomogeneous field, and hence a gradient in the index of refraction over the cross section of the crystal is formed by electrodes applied to opposite faces of the crystal. Breakdown between electrodes is prevented by immersing the entire unit in castor oil. The deflector is controlled by an electric pulse from a photospark discharger. The reproducibility and time stability of pulses is close to 100%, and duration can be continuously controlled over a wide range. The spectral range of operation of the deflector is limited only by the region of transparency of the material (0.35-3.5 μm for lithium niobate). Figures 2, references 2: 1 Russian, 1 Western.
[106-6610]

SOLID-STATE CW LASER IN THE KINEMATIC MODE-LOCKED STATE

KORNIYENKO, L. S., KRAVTSOV, N. V., LARIONTSEV, Ye. G. and SIDOROV, V. A., Scientific Research Institute of Nuclear Physics, Moscow State University imeni M. V. Lomonosov

[Abstract] Previous experimental research has shown that when one of the mirrors moves along the axis of a linear cavity in YAG:Nd lasers, output radiation can be obtained in the form of a sequence of ultrashort pulses recurring with period $T = 2L(t)/c$, equal to the round-trip time of light in the cavity. These pulses have a duration τ much shorter than the period T. This lasing arrangement is called kinematic mode locking. It has been shown that this state can be realized both with a constant rate v of mirror motion, and with harmonic behavior

$v = v_0 \cos \omega_k t$. In this paper a theoretical analysis is made from the physical standpoint of the principal features of kinematic mode locking, and experimental data are given on the way that pulse duration and shifting of the emission away from the center of the amplification line depend on laser parameters in the case of harmonic oscillations of the mirror. It is shown that nonlinear properties of the active medium must be taken into consideration for describing kinematic mode locking as compared with the case $v = 0$. The duration of the ultrashort pulses is modulated with period π/ω_k, and varies from a certain minimum corresponding to the maximum intensity of the second harmonic, to a maximum duration that depends on v_0 and laser parameters, an increase in v_0 reducing the pulse duration. A comparison of intensities of the fundamental and second harmonic in the kinematic mode-locked state shows that the intensity of individual ultrashort pulses on the fundamental frequency is approximately constant with fixed pumping, while pulse duration and power depend on the phase of mirror oscillation. The percentage modulation of pulse amplitude on frequency ω_k/π depends on losses in the optical cavity and on ω_k. Spectral studies show that the laser spectrum in the kinematic mode-locked state shifts in frequency with period $2\pi/\omega_k$. The amplitude of these oscillations may reach 0.5 cm^{-1} with spectral width of the order of 0.1 cm^{-1}. A solid-state cw laser with kinematic mode locking produces ultrashort pulses with duration from 0.15 to 0.6 ns and carrier frequency periodically varying in a range up to 1 cm^{-1} when $v = v_0 \cos \omega_k t$. The state is highly reproducible and does not require frequency stabilization of mirror oscillations or stabilization of laser parameters. This may be the simplest and most reliable method of producing ultrashort pulses in cw YAG:Nd lasers. Figure 1, references 7: 4 Russian, 3 Western.
[106-6610]

INVESTIGATION OF THE EMISSION CHARACTERISTICS OF SOLID-STATE MICROLASERS BASED ON HIGHLY CONCENTRATED NEODYMIUM MEDIA

BALASHOV, I. F., BERENBERG, V. A., TERPUGOV, V. S. and UTOCHKIN, A. V.

[Abstract] Most research on solid-state lasers with concentrated neodymium media has been devoted to the case of continuous pumping. In this paper a theoretical and experimental study is done on the energy characteristics of flash-pumped microlasers. The theoretical analysis is based on solution of a system of kinetic equations with consideration of the actual structure of levels and the spectral-luminescence characteristics of active media. The experimental studies were done on crystals of lanthanum-neodymium ultraphosphate and on aluminum-phosphate neodymium glass with pulsed laser pumping. Relations are derived for the influence of length of the active medium and the coefficient of radiation losses on various microlaser parameters. It is shown that efficiency of actual microlasers is limited by the radiation strength of the active element and thermal effects. To get high

lasing efficiency, the product of length of the active medium multiplied by the coefficient of inactive losses must be less than 0.01-0.02. The authors thank V. A. Pis'mennyy for furnishing the ultraphosphate crystals, and G. O. Karapetyan and A. V. Dmitryuk for the neodymium glass specimens. Figures 5, references 5 Russian.
[106-6610]

SELF-MODULATION OF PLASMA CYCLOTRON MASER RADIATION

BESPALOV, P. A., Institute of Applied Physics, USSR Academy of Sciences

[Abstract] It is shown that single-mode stimulated emission may be unstable in a many-level maser system as compared with a two-level maser. An example of a multilevel system is a plasma cyclotron maser such as may arise in a plasma trap with magnetic mirrors, for example in the Van Allen radiation belts. The comparatively dense magnetized plasma and the ends of the trap form a resonator for extraordinary electron waves (whistlers) with frequencies much lower than the electron cyclotron frequency. The active substance is a small admixture of energetic electrons that have little effect on the dispersion equation, but may amplify the whistlers. The distribution function of high-energy electrons in the mirrortron is anisotropic, and this population inversion may cause cyclotron instability. Analysis of steady-state stability in such a maser system shows that for a certain fairly low power and angular dependence of the source, the steady state of cyclotron wave excitation is unstable relative to perturbations with frequency proportional to the square root of the power of the source. The author thanks V. Yu. Trakhtengerts for discussing the conclusion. References 4: 3 Russian, 1 Western.
[113-6610]

NEW IDEAS IN THE AREA OF LASER DEVELOPMENT

SKOROBOGATOV, G. A., Leningrad State University imeni A. A. Zhdanov

[Abstract] The shortest wavelength on which lasing has been attained so far is 114 Å. It has been proposed that gamma lasers could be made by using a crystal made entirely of a suitable radioactive isomer cooled to the Mossbauer temperature, but theoretical estimates have shown that the amount of isomer necessary for reaching threshold inversion would require thermal neutron fluxes of about

10^{19} -10^{20} cm^{-2} in a time much shorter than the lifetime of the excited level. In this paper the author considers a fundamentally new way of achieving lasing on wavelengths $\lambda < 100$ Å. A theoretical analysis is made of the feasibility of producing beams of hard monochromatic coherent radiation in the wavelength range $\lambda < 20$ Å from softer radiation ($\lambda = 40-100$ Å) produced by powerful lasers by using the "cumulative effect" [G. A. Skorobogatov, PHYS. LETT., 53A, p 72, 1975] in three-boson stimulated scattering (TBSS). It is shown that if two sufficiently strong laser fluxes ϕ_1 and ϕ_2 with wavelengths $\lambda_1 = \lambda_2$ intersect at a certain angle (the angle of "cumulativity") in a third strong flux ϕ_1' of laser radiation with wavelength $\lambda_1' \gg \lambda_1 = \lambda_2$, the three-boson stimulated scattering of photons produces a fourth flux ϕ_2' of monochromatic coherent radiation with wavelength $\lambda_2' = \lambda_1/2 = \lambda_2/2$. Presently available lasers with wavelengths $\lambda_1' = 1-10$ cm and $\lambda_1 = \lambda_2 = 114-1720$ Å can yield values of ϕ_2' adequate for observing individual acts of photon-photon scattering. It should be possible in principle to get fluxes ϕ_2' with efficiency of 10^{-10}-1% (a TBSS frequency doubler). Taking the output of such a device with wavelength shorter than 100 Å to produce crossed beams that intersect with a third flux having a wavelength of 100 cm, it should be possible to make a frequency doubler with efficiency close to 100%. This would make a gamma laser feasible with wavelength $\lambda_1 \cdot 2^{-n}$ in an n-stage TBSS doubler. Figures 2, references 19: 12 Russian, 7 Western.
[112-6610]

PICOSECOND PULSE LASING WITH STIMULATED RAMAN SCATTERING OF BIHARMONIC PUMPING

BOGDANOVA, M. V., KROCHIN, G. M. and KHRONOPULO, Yu. G.

[Abstract] An investigation is made of four-wave parametric interaction of light pulses in the case of biharmonic pumping where one or both components are of picosecond duration. It is shown that if the strong component is a fixed-frequency picosecond pulse, while the weak component is a nanosecond pulse with tunable frequency, parametric stimulation of the Stokes component in biharmonic pumping can be used for efficient stimulated emission of tunable-frequency picosecond pulses. When the steady-state Raman gains are equal, it is best to use a material with shorter transverse relaxation time for parametric conversion of the weak component to the Stokes component. To use biharmonic pumping for pulses of the order of 10^{-12} s or shorter, Raman-active liquids are better than gases, and can give a conversion efficiency of 0.5. For pulses much shorter than the transverse relaxation time, the coefficient of conversion of the intensity of the weak component to the Stokes component is the same for the same pulse energies of strong pumping and its Stokes component regardless of duration. For a fixed duration of the strong pumping pulse, the energy of the Stokes component of weak pumping increases with increasing duration of the weak pumping pulse. In the case of frequency conversion of powerful pulses much longer than the transverse relaxation time and much shorter than the longitudinal relaxation time, it is necessary to take consideration of the unsteadiness of the conversion process due to population movement resulting from stimulated scattering of the strong component of

biharmonic pumping. This reduces the energy conversion coefficient of weak pumping to the Stokes component and sharpens the pulse amplitude of the Stokes component of weak pumping. Figures 6, references 7: 4 Russian, 3 Western. [112-6610]

DEPENDENCE OF EMISSION POWER OF A CO_2 WAVEGUIDE LASER ON THE CURVATURE OF THE RESONATOR MIRRORS

KUZYAKOV, B. A., Institute of Radio Engineering and Electronics, USSR Academy of Sciences, Moscow

[Abstract] Experimental data are given on the output power as a function of the intensity of pumping of the active medium using internal flat and spherical mirrors in the cavity of the waveguide CO_2 laser shown in the diagram. The laser has a two-section ceramic discharge tube 120 mm long and the inside dimension of the waveguide is 2 mm. The radial distribution of the output power was measured in the far zone. Maximum lasing power coupled out of a cavity with flat mirrors having reflectivities of 0.98 and 0.94 was 810 mW at average pressure of $5.3 \cdot 10^3$ Pa in a mixture of $Xe:CO_2:N_2:He = 1:4:3.4:14$. Replacement of one of the mirrors with a spherical mirror reduced power output. However, the results show that stable lasing can be achieved in the cw mode in such a laser with spherical mirrors with radius of curvature of 12 cm or more situated near the end fases of the waveguide.
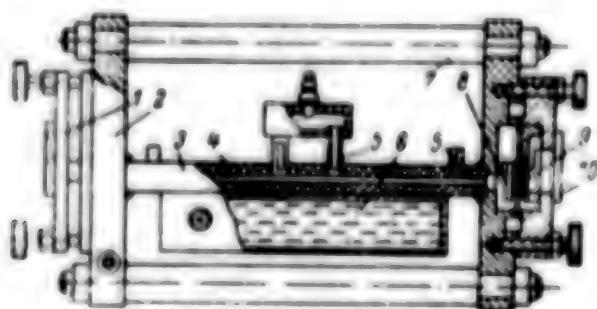
1--adjustable laser head; 2--end flange; 3--ceramic discharge tube; 4--discharge channel; 5--electrodes; 6--cooler; 7--Superinvar rod; 8--Fabry-Perot etalon; 9--resonator mirror; 10--KCL output mirror
[155-6610]

CHARACTERISTICS OF THE XeCl ELECTRIC DISCHARGE LASER

TARASENKO, V. F. and FEDOROV, A. I., Institute of High-Current Electronics, Siberian Department, USSR Academy of Sciences

[Abstract] Previous research on the XeCl electric discharge laser has concentrated on the system of excitation and optimization of the gas mixture. The analysis of the working mechanism of the laser has yielded contradictory results: the formation of $XeCl^*$ molecules has been attributed to the harpoon reaction, ion-ion recombination, and commensurate contributions from both mechanisms. In this paper the authors study the effect that the parameters of the discharge circuit have on XeCl laser characteristics. A diagram of the experimental facility is shown in the figure. Capacitor C_1 of 20 nF was charged by a DC source and switched by thyratron T to capacitor C_2 made up of KVI-3 ceramic capacitors placed on both sides of the laser chamber. The laser chamber was made of Teflon-4, and the capacitors were set against the chamber to minimize inductance of the discharge circuit. Preliminary irradiation was provided by glass tubes with wires inside that were connected to the anode. The tubes were placed near the cathode. The optical cavity was formed by an aluminized mirror and a plane-parallel quartz plate. Mixtures of He, Xe and CCl_4 were premixed and admitted periodically to the laser chamber. Voltage and discharge current were measured by a voltage divider and current shunt with display on the I2-7 oscilloscope. Emission characteristics were determined by the IMO-2, FEK-22 and ISP-30 instruments. It was found that the unsaturated gain is 15% per centimeter. The results of the experiments show that $XeCl^*$ molecules are formed most effectively by ion-ion recombination of xenon and negative halide ions. Figures 6, references 8: 4 Russian, 4 Western.

To oscilloscope
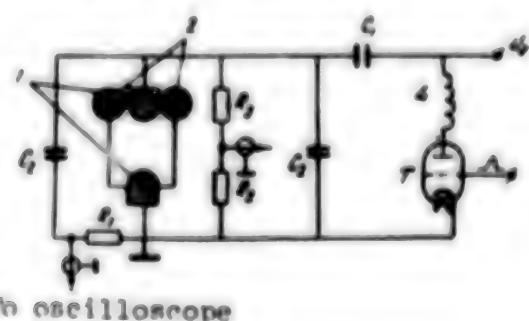
1--electrodes; 2--glass tubes with wires inside
[154-6610]

FEASIBILITY OF A LASER-ACTIVE MEDIUM BASED ON H_3^* EXCIMER

GRINCHENKO, B. I. and KARLASHOV, A. V., Institute of High Temperatures, USSR Academy of Sciences

[Abstract] An analysis is made of the kinetics of population of H_3^* excimer molecules in a plasma produced by electron-beam excitation of a mixture consisting chiefly of argon with small amounts of hydrogen and iodine. The authors list 18 reactions that determine the kinetics of formation of the excimer, and also their rate constants. Analysis of the equations of balance of the number of particles in the plasma with consideration of the number of ionizations in a cubic centimeter per second shows that under near-optimum conditions the concentrations of hydrogen and iodine are 10^{18} and 10^{17} cm^{-3} respectively. It can be seen that as the beam current increases the gain first increases, and then decreases due to an increase in the role of dissociative recombination and quenching of the excimer molecules. Efficiency decreases monotonically with increasing beam current due to an increase in the contribution of dissociative recombination to the general nature of the recombination processes. Figures 2, references 10: 8 Russian, 2 Western.
[152-6610]

RADIAL CHARACTERISTICS OF STIMULATED EMISSION OF A COPPER-VAPOR LASER

SOLDATOV, A. N., SHAPAREV, N. Ya., KIRILOV, A. Ye., GLIZER, V. Ya., POLUNIN, Yu. P. and FEDOROV, V. F., the Optika Special design Office of Instrument Making, Siberian Department, USSR Academy of Sciences

[Abstract] One way to raise the efficiency and average power of copper-vapor lasers is to increase the recurrence rate of the pulse discharge and the volume of the active medium. However, reducing the period between pulses leads to cumulative effects that determine the state of the medium preceding a new pulse (accumulation of heat, electron concentration and metastable atoms). These effects reduce the average and pulse power of emission. This power reduction involves an effect in which power drops off first in the center of the tube, resulting in annular beam structure. This effect shows up at lower recurrence rates as the diameter of the working channel increases. This paper gives some experimental data on the phenomenon, and offers an explanation based on the radial characteristics of the active medium. Figures 4, references 7: 6 Russian, 1 Western.
[160-6610]

INVESTIGATION OF NONLINEAR WAVES ON THE SURFACE OF A LIQUID METAL IN AN ELECTRIC
FIELD

GABOVICH, M. D. and PORITSKIY, V. Ya., Institute of Physics, UkSSR Academy of
Sciences

[Abstract] A method is described for studying instability of the surface of
liquid metal in an electric field perpendicular to the surface. The technique
involves rapid solidification of the metal with fixation of the surface relief
produced by the action of the electric field and the oppositely directed effect
of surface tension. A scanning electron microscope is then used to study the
frozen nonlinear capillary waves. The surface is melted and a strong electric
field is produced by a dense stream of ionized hydrogen plasma transported by a
strong magnetic field in vacuum to a copper plate held at negative potential
relative to the plasma and acting as an ion collector. Exposure continues until
the central portion is melted and wavelets form on the edge of the crater. Ex-
perimental results are compared with theoretical data. Figures 2, references 4:
2 Russian, 2 Western.
[148-6610]

INVESTIGATION OF MHD STABILITY OF A COMPACT TORUS

POPOV, A. M. and SHABAROV, A. Yu.

[Abstract] Interest has recently increased in MHD equilibrium and stability of
a toroidal plasma configuration that contains a closed magnetic field limited by
a separatrix of quasispherical or elliptical shape. Such systems with aspect
ratio $R/a \to 1$ (R and a are the major and minor radii of the torus respectively)
are called compact toroidal systems. In this paper the authors study the MHD

instability of a plasma in a compact torus with respect to large-scale nonlocal displacements with a free surface. An analytical solution is found for the equation of equilibrium. The energy principle is then used to study the solution in the linear approximation for stability. The goal of this study is to find the variation δW of the potential energy on the given displacement. If it is found that $\delta W < 0$, the given displacement leads to instability. Instability was studied with respect to displacements satisfying the condition of incompressibility div $\zeta = 0$, which can be expressed in a cartesian coordinate system as: 1. displacement along the principal axis Z of the torus (axially symmetric displacement); 2. displacement along the X axis (sidewise displacement); rotation about the Y axis (tilting). Conditions of instability are obtained for the given plasma configurations. It is shown that equilibrium can be specified such that these types of displacements do not lead to instability. Figures 2, references 2 Russian.
[105-6610]

EVALUATING THE ACCURACY OF THE NET-POINT METHOD OF CALCULATING THE ELECTRICAL CHARACTERISTICS OF AN MHD GENERATOR CHANNEL

BLITSHTEYN, A. A., GUSEV, Yu. P., PISHCHIKOV, V. I. and PISHCHIKOV, S. I., Institute of High Temperatures, USSR Academy of Sciences, Moscow Power Engineering Institute

[Abstract] One of the most promising methods of calculating the electrophysical parameters of MHD channels is the use of electric networks containing active and passive elements. An examination is made of the problem of minimizing the number of cells in the networks without adversely affecting the accuracy of calculations. The initial data were the results of gasdynamic calculation corresponding to the maximum power registered in the second startup of the U-25B MHD facility. Under conditions of considerable transverse inhomogeneity of the plasma parameters, the accuracy of the calculation is determined by the number and sizes of the network cells in the transverse direction of the channel. Comparison with the results of calculation of the first channel on the U-25B facility shows that the use of electric networks enables consideration of the two-dimensional inhomogeneities of the plasma parameters without special correction factors that characterize the transverse inhomogeneity of conductivity. The results of the model problem on flow of current across the channel can be used for preliminary estimates of the minimum necessary number of layers along the y-axis and their transverse dimensions to optimize accuracy of calculation of the integrated electrophysical characteristics of MHD generator channels. Figures 3, references 8: 6 Russian, 2 Western.
[102-6610]

NUMERICAL INVESTIGATION OF UNSTEADY PROCESSES IN A FARADAY MHD GENERATOR

VINOGRADOVA, G. N. and PANCHENKO, V. P., Institute of Nuclear Energy
imeni I. V. Kurchatov

[Abstract] An examination is made of some probelms that arise in designing high-
efficiency supersonic MHD generators with one-piece electrodes. A numerical
analysis is made of the process of reaching steady-state operating conditions in
a Faraday MHD generator with resistive loading, unloading and load reduction. An
explicit "predictor-corrector" scheme with non-central differences is used for
solution of the partial differential equations. Curves are given showing the
lengthwise distribution of time-variable pressure, current density and temperature
in the channel. When the load is disconnected, the transient process is monotonic,
and the steadying time is approximately two transit times. The loading process
is accompanied by the formation of compression waves and an abrupt change in cur-
rent density. The time for reaching the steady state is about 4 times the trans-
ient time when the load is cut off. When the load resistance is cut in half, there
is an abrupt drop in voltage on the initial stage of the process and an increase
in current density at the inlet end of the channel with formation of a compression
wave. The main interaction of the flux with the magnetic field occurs in the com-
pression wave. The main interaction of the flux with the magnetic field occurs
in the compression wave, which is rapidly decelerated. There is a smooth reduc-
tion in parameters downstream through the remainder of the channel. Within one
transit time the voltage drops strongly, and then rises to the steady-state value,
which is 70% of the nominal. The authors thank A. V. Gubarev, V. V. Breyev and
O. I. Pechenova for constructive discussions and assistance with the work.
Figures 15, references 10: 6 Russian, 1 Polish, 3 Western.
[102-6610]

VARIATIONAL PRINCIPLE OF DERIVING MAGNETOHYDRODYNAMIC EQUATIONS IN MIXED LAGRANGIAN-EULERIAN VARIABLES

GOLOVIZNIN, V. M., SAMARSKIY, A. A. and FAVORSKIY, A. P., Moscow

[Abstract] The authors propose a variational principle as a basis for construc-
ting discrete models of a continuum in mixed Lagrangian-Eulerian variables. This
is a fundamental step in adapting the variational approach to dynamic equations
of adiabatic magnetohydrodynamics. A detailed examination is made of variational

formulation of two-dimensional equations in cases of planar and axial symmetry. The resultant discrete models can be used to calculate flows with strong deformations with retention of important properties of variational models in Lagrangian variables such as the property of total conservativenes.. In application to adiabatic magnetohydrodynamics, the proposed variational principle yields six dynamic equations, any three of which can be represented as a linear combination of the other three. References 8: 6 Russian, 2 Western. [150-6610]

NUCLEAR PHYSICS

CALCULATING THE PROFILE OF A MOLECULAR BEAM FORMED BY A SYSTEM OF CHANNELS

ZAYTSEV, Yu. V. and OVCHINNIKOV, A. A., Petrozavodsk State University
imeni O. V. Kuusinen

[Abstract] The total particle flux from the molecular beam shaper and the
particle concentration distribution through the molecular beam cross section
were investigated. A series of equations was derived to calculate two inter-
secting molecular beams. The distribution of atom concentration through the
cross section of a beam form by a cylindrical channel decreases as the distance
from the axis increases. The arrangement of the channels in the shaper has a
significant effect on the nature of distribution of atom concentration. The
maximum concentration of atoms at which molecular flow of the gas through the
chamber occurs is shifted toward large values, which provides greater density
of atoms in the beam. Figures 3, references: 1 Russian.
[120-6521]

EFFICIENCY OF A MOLECULAR NANOSECOND AMPLIFIER

AVER'YANOV, N. Ye. and BALOSHIN, Yu. A., Leningrad Institute of Precision
Mechanics and Optics

[Abstract] The possibilities of increasing the efficiency of energy conversion
in a molecular nanosecond amplifier are analyzed numerically. The amplification
factor of the medium varies in time and decreases overall in a multipass nano-
second amplifier. The energy characteristics and energy conversion coefficient
are dependent on the number of passes at two lengths of the input pulse. Fre-
quency pulling is more intensive in the area of the first radiation peak.
Figures 4, references 12: 5 Russian, 7 Western.
[120-6521]

QUANTUM ELECTRON BEAM MODULATION WITH STIMULATED DIFFRACTION EFFECT

AVETISYAN, G. K. and DZHIVANYAN, A. A.

[Abstract] Quantum modulation at the beginning of a homogeneous electron beam at external wave frequency and its harmonics was investigated with respect to arbitrary openings in an opaque screen. After interaction, the free state of the electrons is a set of plane waves with different energies which correspond to the single-photon stimulated diffraction process. Quantum modulation of density at the beginning of a homogeneous electron beam is revealed if these states are superimposed. The depth of modulation on the main frequency for a beam passing through a slit approaches a value of 1, to which the laser field intensity and output density correspond. References 15: 6 Russian, 9 Western.
[120-6521]

ANGULAR DISPERSION AND TRANSIT TIME CHARACTERISTICS OF A SYSTEM OF ELECTROSTATIC SPHERICAL AND CYLINDRICAL MIRRORS

ZASHKVARA, V. V. and ASHIMBAYEVA, B. U., Institute of Nuclear Physics of the Kazakh SSR Academy of Sciences, Alma-Ata

[Abstract] A spherical electrostatic reflector is positioned with its center on the axis of symmetry of a system of two concentric electrostatic cylindrical reflectors. While it was shown that such a system can operate in a zero linear dispersion mode with respect to energy in an earlier paper by the authors [ZHURNAL TEKHNICHESKOY FIZIKI, 50, p 2593 (1980)], where the charged particle beam is focused on the axis of symmetry with a precision of down to the square of the divergence angle and the angular cubic aberration is always positive, this paper continues the analysis of the system to point out two inherent features: 1. In the zero linear dispersion mode, the system has considerable energy angular dispersion; 2. The charged particle transit time for particles of the same mass and energy via different beam trajectories can be the same in a second approximation with respect to the divergence angle. This means that the system is capable of operating as an energy analyzer and a transit time discriminator. Analytical expressions are derived for the angular dispersion and the transit time. Schematic drawings also show the charged particle trajectories in the system for various values of the energy in the zero linear energy dispersion mode. Figures 4, references 3 Russian.
[116-8225]

INVESTIGATION OF TRANSFER OF EXCITATION IN THE SYSTEM $He(2^3S_1) + Ne(2^1S_0)$ BY THE METHOD OF OPTICAL ORIENTATION OF ATOMS

ZHITNIKOV, R. A., KARTOSHKIN, V. A., KLEMENT'YEV, G. V. and MEL'NIKOV, V. D., Physicotechnical Institute imeni A. F. Ioffe, USSR Academy of Sciences

[Abstract] An investigation is made of the transfer of excitation from helium to neon in the process $He(2^3S_1) + Ne(2^1S_0) \rightarrow Ne(2s_2, 2s_3) + He(1^1S_0)$. The experiments are based on the method of optical orientation of atoms, which enables practically direct measurement of the rate constant of the process of excitation transfer from triplet metastable helium atoms to neon atoms. This technique involves transfer of the angular momentum from circularly polarized light to an ensemble of helium atoms in the triplet metastable state. Resonant emission of a helium pumping lamp was used for optical orientation of the magnetic moments of the He* atoms. The absorption chamber filled with He^4 or a mixture of $He^4 + Ne$ was placed in a homogeneous magnetic field of about 80 A/m directed along the pumping beam. An oscillating magnetic field perpendicular to this direction was used to set up magnetic resonance in the system of Zeeman sublevels of the 2^3S_1 state of helium. Resonance signals were recorded with respect to absorption of the pumping light on 1.08 μm. It was found that the cross section of the excitation transfer process at 300 K is $\sigma = 0.35 \text{ Å}^2$, and at 178 K it is $\sigma = 0.06 \text{ Å}^2$. Analysis of the experimental results on the basis of the Rosen-Zener-Demkov model of atomic collision theory gives the parameters of exchange interaction $A = 8 \cdot 10^3$ $\alpha = 1.38$ (in atomic units) in the approximation of the nondiagonal matrix element $\Delta = Ae^{-\alpha R}$ for internuclear distances R of the order of 7-9 atomic units. The rate constants of the given process calculated at temperatures of 300-700 K with the use of these values of the exchange interaction parameters agree with experimental results, which shows that the proposed model gives a good explanation of the temperature dependence of the rate constant of the process. Figures 3, references 20: 5 Russian, 15 Western.
[134-6610]

ORIGINATION OF SOLITONS IN PULSE NMR EXPERIMENTS IN THE A-PHASE OF He^3

FOMIN, I. A., Institute of Theoretical Physics imeni L. D. Landau, USSR Academy of Sciences

[Abstract] The order parameter in the A-phase of He^3 is characterized by a spin vector $\vec{d}$ and an orbital vector $\vec{l}$. Their mutual orientation in the volume of the liquid is determined by spin-orbital interaction with energy $U = -\frac{\Omega_A^2}{2\omega_L}(\vec{l}, \vec{d})^2$, where

Ω_A is the frequency of longitudinal oscillations, and ω_L is the Larmor frequency. U has two energetically equivalent minima $\vec{d} \parallel \vec{l}$ and $-\vec{d} \parallel \vec{l}$, and in this connection there may be domains of two types. The wall of domains with different relative orientation of $\vec{d}$ and $\vec{l}$ is a planar soliton. Since formation of a domain wall involves expenditure of additional energy, the single-domain state is more advantageous, and many-domain states must be specially prepared. In this paper a theoretical analysis is made of the technique of preparing the soliton state by the formation of domain walls in the A-phase of He^3 upon relaxation of magnetization to equilibrium after deflection through a large angle. The theoretical explanation of this method is based on the fact that spatially uniform precession of magnetization in the A-phase is unstable. Spatially inhomogeneous solutions of equations of spin dynamics are found that describe steady-state precession that develop into planar solitons upon relaxation. References 7: 4 Russian, 3 Western.
[148-6610]

SOME METHODS OF PRODUCING HIGH-ENERGY POLARIZED ELECTRON BEAMS ON PROTON SYNCHROTRONS

BESSONOV, Ye. G. and VAZDIK, Ya. A., Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences

[Abstract] Unpolarized high-energy electron beams are currently being produced on large proton synchrotrons. In this paper the authors consider several versions of producing polarized electron beams based on transmission of part of the kinetic energy of ultrarelativistic protons to the electrons in a thin target in the working region of a synchrotron, and multiple passage of the proton beam through the target. Three arrangements are considered in which a target with polarized electrons is used: a thin film of ^{26}Fe with magnetization to enhance polarization to 28% by using the effect of proton channeling, and to provide control of the direction of the polarized beam by changing the direction of the external magnetic field; a beam of polarized hydrogen atoms directed along one of the linear gaps of the proton accumulator; a magnetic trap confining an electron-positron plasma of polarized particles placed in a linear gap of the proton accumulator. It is shown that the proposed technique can be used to produce polarized electron beams with energy of 100 Gev, energy spread of $+5\%$ and intensity of 10^7 electrons/s with 30% polarization, and intensity of 10^4-10^5 electrons/s with polarization near 100%. The authors thank Yu. M. Ado and B. B. Govorkov for discussing the work, and also Ye. I. Tamm for interest and support. References 11: 8 Russian, 3 Western.
[109-6610]

ELECTRON SCATTERING OF NEUTRINOS (ANTINEUTRINOS) IN A CONSTANT HOMOGENEOUS MAGNETIC FIELD

TSVETKOV, V. P., Kalinin State University

[Abstract] An experimental study of $\nu e(\bar{\nu}e)$ scattering is important for under-
standing weak interactions. Fundamentally new information on the interaction
between neutrinos and electrons could be obtained by measuring such scattering
on a polarized electron target. Since such a target is feasible with the use
of a strong magnetic field, the authors undertake a theoretical calculation of
this scattering process in a constant homogeneous magnetic field. Expressions
are derived for the probability of scattering of neutrinos (antineutrinos) by
an electron polarized in a magnetic field. It is shown that the ratio of total
excitation cross sections in weak and strong magnetic fields increases from
1 to 2.75 with increasing energy from 1 keV to 10 MeV. The author thanks
B. K. Kerimov and A. V. Borisov for constructive comments. References 4:
3 Russian, 1 Western.
[109-6610]

PHYSICAL AND MATHEMATICAL MODELING OF RELATIVISTIC ELECTRON BEAM TRANSPORT IN AN EXTERNAL MAGNETIC FIELD

ALEKSEYEV, B. V., IL'IN, A. A., KRUTILINA, V. M. and NESTEROV, G. V., Moscow
Aviation Institute imeni S. Ordzhonikidze

[Abstract] An investigation is made of relaxation of an electron beam in a gas
in an axially symmetric magnetic field. Experiments were done on a facility con-
sisting of an electron accelerator, a system for coupling the beam out of vacuum
into the atmosphere, a relaxation chamber enclosed in a solenoid, and recording
instrumentation. The electron beam had kinetic energy of 750 keV and average
current of 300 µA. The frequency of beam pulsations was 50 Hz, pulse duration
was about 4 ms. Beam diameter at the output of the accelerator was no more than
6 mm, angular divergence was about 0.03 rad. The beam was coupled into the re-
laxation chamber from the accelerator through two sheets of titanium foil 50 µm
cooled by nitrogen blown between them. The relaxation chamber was a steel tube
with inside diameter of 50 mm, wall thickness of 3 mm and length of 800 mm.
Current pickups inside the chamber were isolated from the housing and from each
other. The surrounding solenoid produced an induction of 2.5 T. Measurements
were done in a xenon-filled chamber at different pressures. The beam configura-
tion and the longitudinal and transverse energy distribution were determined as

well as the currents of deposition on the walls of the chamber. Experimental
and theoretical results are compared. The authors thank A. S. Koroteyev and
S. B. Karasev for discussing the results and for constructive criticism during
the work. Figures 6, references 9: 8 Russian, 1 Western.
[102-6610]

QUANTUM SHOCK WAVES IN NUCLEAR MATTER

KURILKIN, N. N., MISHUSTIN, I. N. and KHODEL', V. A., Institute of Atomic Energy
imeni I. V. Kurchatov

[Abstract] An investigation is made of the propagation of waves of finite ampli-
tude in cold nuclear matter. It is shown that nonlinear terms in the equation of
the Fermi fluid lead to solutions of the soliton type. When dissipative effects
are taken into consideration, these perturbations do not evlove in accordance
with the laws of classical hydrodynamics, and they take on the characteristics of
quantum shock waves. As a nonlinear traveling wave gives up its energy to in-
dividual particles, a near-maxwellian spectrum is formed, i. e. a system that re-
mains cold while acting as a hot body with effective temperature $T \sim (2\pi\Delta)^{-1}$,
where Δ is the size of the soliton. In contrast to classical hydrodynamics, the
compaction of matter in the nonlinear quantum wave takes place with negligible
heating, which should be important in microscopic generalization of the spectator-
participant model that is now being successfully applied to collisions of high-
energy heavy ions. In the proposed theory, only the simplest one-dimensional
motions are analyzed. Many important problems remain unsolved, such as emergence
of the nonlinear wave at the surface of the nucleus, dissociation of the strong
initial perturbation into solitons, evolution of the state of nuclear matter
behind the quantum shock wave front and so on. The use of quantum concepts in
this field should help to answer many of these questions in the dynamics of
nuclear collisions. The authors thank S. T. Belyayev, V. M. Galitskiy and
V. A. Khangulyan for constructive discussion. Figures 2, references 12:
8 Russian, 4 Western.
[108-6610]

CHANGE IN ENERGY OF A CHARGED PARTICLE WITH MOTION IN THE FIELD OF A DECELERATED
ELECTROMAGNETIC WAVE

VOLODIN, B. A., KHALILOV, V. R. and KHAPAYEV, A. M., Moscow State University
imeni M. V. Lomonosov

[Abstract] A differential equation is derived for a charged particle in the
field of a decelerated electromagnetic wave as a function of the length of the
interaction region. The solution of this equation gives the amplitude and period
of energy variation directly as a function of the drift space length. The authors
consider an example of prolonged interaction of charged particles with an electro-
magnetic field with regard to conditions of phase synchronism, i. e. assuming
that the phase velocity of the wave is approximately equal to the component of
particle velocity in the direction of wave propagation. It is shown that the
period of oscillations of the energy of the charged particle is dependent on the
angle between the direction of transverse velocity of the particle and the direc-
tion of the field strength vector. Figures 3, references 6 Russian.
[154-6610]

ELASTIC SCATTERING OF HIGH-ENERGY ELECTRONS BY ATOMS

ABAKUMOV, A. I. and VINOGRADOV, V. S., Moscow Aviation Institute
imeni Sergo Ordzhonikidze

[Abstract] An investigation is made of elastic scattering of fast electrons by
atoms. A method is presented for numerical calculation of the differential,
total and transport cross sections of scattering. Data are given on scattering
of fast electrons with energy of 10 keV-1 MeV by neutral atoms of uranium,
silver, argon, aluminum and oxygen. The analysis applies to the relativistic
problem of electron scattering in the stationary potential field of a neutral
zero-spin particle. Approximating formulas are derived for scattering cross
sections as a function of electron energy. The results can be used for fairly
accurate calculations of elastic scattering of electrons by neutral particles
in problems of mathematical modeling of processes of electron transport in
various media. Figures 3, references 11: 10 Russian, 1 Western.
[152-6610]

ALGORITHM FOR CALCULATING SCALAR POTENTIAL IN A BEAM-SHAPING PROBLEM

MOKIN, Yu. I., Moscow

[Abstract] An examination is made of a problem that is central to the job of
forming relativistic electron beams in a vacuum waveguide: calculation of the
scalar potential from the trajectories of charged particles. The specifics of
this problem require methods that are at the same time reliable, economic, and
permit calculation of the potential values in a predetermined set of points.
An algorithm is proposed for calculating singular integrals that is based on
the results of previous research by this author [see Yu. I. Mokin, "Algorithmic
Peculiarities of Determination of the Trajectories of Relativistic Electrons in
a Self-Consistent Electromagnetic Field," ZHURNAL VYCHISLITEL'NOY MATEMATIKI I
MATEMATICHESKOY FIZIKI, Vol 19, No 6, 1979, pp 1485-1495]. Methods of potential
theory that allow calculations in any point of the defined region are used for
finding the harmonic function. It is shown that most of the volume of work in
computing the scalar potential is spent on repeated calculation ($\sim 10^6$ times) of
the singular function $G_0(r, z; \xi, n)$. This enables the use of parallel processing,
which brings about a considerable improvement in efficiency. The computer memory
required for calculating the potential on real grids (10-20 points on a unit of
length of the emission zone) does not exceed 20,000 words. Attainment of an
accuracy of $O(N^{-1})$ requires $O(N^3)$ arithmetic operations. Economic methods of
realizing the proposed algorithm are discussed. References 4 Russian.
[150-6610]

THREE-BEAM HOLOGRAPHIC INTERFEROMETRY OF DIFFUSELY REFLECTING OBJECTS

VLASOV, N. G., GALKIN, S. G. and SEMENOV, E. G.

[Abstract] The area of application of three-beam holographic interferometry which permits a doubling of sensitivity is applied to diffusely reflecting objects. The hologram was recorded by triple exposure and the reference beam was rotated prior to the second and third exposures by shifting the lens. Moire patterns corresponding to an interferogram with double sensitivity are formed on a three-beam interferogram. Patterns of finite width form due to rotation of the reference beam rather than the object beam. Figures 2, references 4: 3 Russian, 1 Western.
[120-6521]

PROPAGATION OF COHERENT OPTICAL PULSES UNDER TWO-PHOTON RESONANCE CONDITIONS

YELYUTIN, S. O., MAYMISTOV, A. I. and MANYKIN, E. A.

[Abstract] The process of propagation of an ultrashort electromagnetic radiation pulse during resonance at double frequency of the control field was investigated. A system of nonlinear differential equations is solved to analyze the coherent propagation of ultrashort light pulses in a resonance medium. The high-frequency Stark effect plays a significant role on broad resonance lines. The coherent interaction of the field with the medium is not significantly affected by the Stark shifts of resonant frequencies on the background of a broad excitation pulse spectrum. The effect of Stark shifts on interaction of ultrashort pulses with the medium is intensified in the coherent radiation flux is high. Figures 5, references 25: 11 Russian, 14 Western.
[121-6521]

CHARACTERISTICS OF A STIMULATED LIGHT ECHO FORMING IN A MOVING PARTICLE SYSTEM

NEFED'YEV, L. A. and SAMARTSEV, V. V.

[Abstract] The effect of the motion of working particles and their collisions
with variation of velocity on the characteristics of a stimulated light echo was
investigated. Kinetic equations are derived to explain the optical transient
phenomena in gases with respect to both the Doppler frequency shift of the parti-
cles and their position in space. If the wave vectors of the exciting pulses are
not parallel, the intensity of the stimulated light echo response is more strongly
affected by collisions as particle velocity varies. References 7: 6 Russian,
1 Western.
[121-6521]

DISTORTION OF A GAUSSIAN BEAM BY A THERMAL LENS THAT ARISES IN OPTICAL COMPONENTS

BELUGA, I. Sh., VINEVICH, B. S. and KOLOSOVSKAYA, L. A.

[Abstract] Nonuniform heating of optical elements by a cv laser beam produces a
thermal lens that changes the radiation pattern of the beam. The authors calcu-
late the effect of such a lens on the polar pattern of a gaussian beam and on the
power percentage in a predetermined angle in the far zone. In the analysis it is
assumed that the beam has a plane wavefront, and is incident on the center of a
plate. Heat is carried to the edges of the plate only due to the heat conduction
of the material. The action of nonuniform heating changes the geometry of the
plate and its index of refraction, depending on temperature and deformations. It
is shown that the stronger the heat lens, the less will be the power that passes
through a given angle in the far zone, and the broader will be the polar patterns
of the beam. Experiments with gaussian beams on optical elements made of Ge,
GaAs and ZnSe confirm the theoretical conclusions. It is shown that the heat lens
can be partly compensated by an ideal quadratic lens. For most optical materials
used in the 10.6 μm band the thermal lens is appreciable when the power absorbed
in an optical component is 1-5 W. Figures 5, references 3: 2 Russian, 1 Western.
[157-6610]

OPTICAL STRENGTH OF YTTRIUM-ERBIUM GLASSES ON A WAVELENGTH OF 1.54 μm

ARTEM'YEV, Ye. F., MURZIN, A. G. and FROMZEL', V. A.

[Abstract] An experimental study is done on the volumetric and surface optical
strength of yttrium-erbium glasses used for active elements in monopulse lasers
on 1.54 μm. The duration of the irradiating pulse was measured by a visualizer
using LiNbO$_3$ powder, and the photosensor was an FEK-0.9 photocell. The results
showed a pulse duration at half-amplitude of 35 ns. The pulse energy and focused
spot diameter were also measured. Curves for the threshold of volumetric destruc-
tion as a function of spot size are hyperbolic. Comparison with similar tests of
K8 optical glass shows that the surface otpical strength is unaffected by a change
in wavelength of irradiation in a range of 1-1.5 μm. Figures 2, references 5:
4 Russian, 1 Western.
[157-6610]

LATTICE STRUCTURE OF AN OPTICAL SIGNAL

ABLEKOV, V. K., SYRYKH, Yu. P., FROLOV, A. V. and KOLYADIN, S. A.

[Abstract] The signal produced in optical systems can be described by analytical
functions. If $f(x)$ is the distribution of the field in the object plane, the
optical signal in the wave field can be represented as

$$F(z) = \int_{-A}^{A} f(x) \exp(izx)\, dx,$$

where $[-A, A]$ is a linear dimension of the object, and $z = (x + iy)$ is a comp!
variable. It is shown that the distribution of zeros of function $F(z)$ at large
z is determined by the finiteness of the object, which means that the boundary
points of the object that form maximum spatial frequencies in the wave zone pro-
duce a fundamental lattice in this zone with period ~1/2A. This lattice is modu-
lated as light is scattered by the object, i. e. the spatial frequencies of field
distribution on the object lead to a shift of the zeros of function $F(z)$, and
thus to deformation of the fundamental lattice. In a real experiment, the in-
tensity distribution is given by

$$I(z) = F(z)F^*(z).$$

It is shown that $I(z)$ has the same zeros as function $F(z)$, and therefore the field pattern can be reconstructed from the intensity pattern. Thus the lattice structure of the optical signal, being characterized by the size of the object, can be treated as an analog of the spatial carrier in holography with a reference beam. Thus the analytical representation of an optical signal gives information on the object that is contained in the light wave in the form of a fundamental lattice characterized by the boundary of the object. References 9: 6 Russian, 3 Western.
[131-6610]

RAYLEIGH SCATTERING OF SHORT LIGHT PULSES BY INCLUSIONS IN TRANSPARENT MEDIA

GRIGORYAN, M. M., NIKOGOSYAN, A. S. and POGOSYAN, P. S., Yerevan State University

[Abstract] A qualitative investigation is made of some characteristics of pulse scattering by inclusions in transparent media in the optical range. Media are considered that satisfy the condition $a \ll \lambda \ll l$, where a is the average dimension of an inclusion, and l is the average distance between inclusions. Since all solid materials used in quantum electronics satisfy this condition, the analysis can be limited to single scattering and still cover a wide range of materials that are of considerable interest for practical applications. It is shown in particular that the distinguishing features of scattering of short light pulses can be used to determine the time characteristics of mode-locked laser emission. References 3 Russian.
[132-6610]

ELECTROSTRICTION CHANGE IN THE INDEX OF REFRACTION OF GLASSES IN LASER BEAMS OF ELLIPTICAL CROSS SECTION

DEMENT'YEV, A. S., MALDUTIS, E. K. and SAKALAUSKAS, S. V.

[Abstract] The authors propose a method for calculating the electrostriction deformations and the electrostriction change in the index of refraction induced in isotropic optical solids by an elliptically polarized laser beam with arbitrary

cross sectional distribution of intensity. Analytical expressions are found for electrostriction deformations and change in the index of refraction and for birefringence in the center of a beam with elliptical gaussian distribution of intensity with respect to cross section for any polarization of emission. It is shown that the induced nonlinear change in the index of refraction due to electrostriction can be varied over a wide range by appropriate choice of the cross sectional geometry and polarization of a gaussian beam. Figures 4, references 17: 9 Russian, 8 Western.
[104-6610]

OPTOELECTRONICS

CORRECTING NONLINEAR DISTORTIONS OF LIGHT BEAMS BY AN OPTICAL SYSTEM WITH FEEDBACK

VORONTSOV, M. A. and CHESNOKOV, S. S., Moscow State University imeni M. V. Lomonosov

[Abstract] Coherent adaptive optical systems have received considerable attention in recent research. These are optical systems with feedback that are used for controlling the phase of optical beams. The authors consider adaptive optical systems with an emitted wave in which feedback is accomplished by coupling of the phase front of the wave scattered by the object within the limits of the receiving-transmitting aperture. Operation of such a phase-coupled system is modeled under conditions of a nonlinear regular medium of light beam propagation. Based on the results of numerical modeling, an analysis is made of the feasibility of using this system to focus radiation in a nonlinear medium by suppressing thermal blurring of the beam. A method is proposed for improving the stability of an adaptive system under conditions of strong nonlinearity. The results show that optical systems with feedback should be effective in suppressing effects of self-stress. Figures 4, references 9: 5 Russian, 4 Western.
[160-6610]

GENERATION OF NONLINEAR LOW-HYBRID PLASMA WAVES AND SOLITONS IN A CONTINUOUS
PUMPING FIELD

BRAZHNIK, V. A., GRISHAYEV, V. I., DEMCHENKO, V. V., OMEL'CHENKO, A. Ya.,
PAVLOV, S. S. and PANCHENKO, V. I.

[Abstract] The stationary structure of a rapid magnetoacoustic wave field was
investigated in the low-hybrid resonance range with regard to the high frequency
of the wave field pressure, thermal motion of plasma particles and pair collisions.
Generation and the dynamics of solitons were studied in the low-hybrid resonance
range in a continuous pumping field. The field amplitude is restricted if spatial
dispersion is taken into account but the field amplitude is relatively high.
Striction nonlinearity reduces the spatial period of field oscillations. Soliton
generation in a cold plasma is periodic in time, which agrees with the quasi-
collapse theory of Langmuir waves in an isotropic plasma. Standing monochromatic
waves of finite amplitude were investigated in the range of low-hybrid resonances.
References 40: 32 Russian, 8 Western.
[120-6521]

IMPACT OF AN INTENSE ELECTROMAGNETIC WAVE ON AN INHOMOGENEOUS PLASMA

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[Abstract] A plasma waveguide was produced with microwave ionization by a wave
propagating in a conducting shell 80 cm in diameter and 100 cm long. The micro-
wave pumping pulse was 2 microseconds wide at a frequency of 2.8 GHz. The
pumping power varied from 1.0 to 15 MW (the corresponding pulse energies ranged

from 2 to 30 joules). The microwave power was delivered via a rectangular wave-guide (TE_{01} mode) from a KIU-12AM accelerating klystron. A directional coupler made it possible to compare the level of the reflected signal with the incident power, i. e. measure the reflection factor and the related coefficient of the transformation of the electromagnetic field to a plasma wave at the plasma boundary. The group velocity was measured with four probes which registered the H component at distances of 32, 35, 71 and 74 cm from the pumping point. When the pressure in the waveguide changed from 10^{-4} to 10^{-3} torr, the group velocity ranged from 10^8 to $7 \cdot 10^8$ cm/sec. With an increase in power, the reflection from the plasma falls off rapidly, and at a pumping power of 10 - 15 MW, the reflectivity is about 0.2, i. e., neglecting ionization losses (which amount to 10^{-2} joules for a plasma density n of about 10^{12} cm^{-3}), there is efficient transformation (on the order of 80%) of the pumping wave to a surface wave. An increase in the plasma density also leads to an increase in the reflectivity, though at power levels above 15 MW, the reflectivity is less than 0.3, even at high plasma density. A tendency is noted towards a reduction in the reflectivity with a rise in the pumping power. The discussion of the results is limited to a treatment of the transformation phenomenon to ascertain those parameters on which the reflectivity should depend; plasma density inhomogeneities and the microwave pressure forces are taken into account. A simple analytical expression is proposed for the reflectivity. Figures 4, references 15: 9 Russian, 6 Western.
[116-8225]

HALL END-TYPE COLD-CATHODE PLASMA ACCELERATOR

DORODNOV, A. M., MUBOYADZHYAN, S. A., POMELOV, Ya. A. and STRUKOV, Yu. A., Moscow

[Abstract] The authors study a new kind of Hall end-type cold-cathode plasma accelerator that operates on products of erosion of the cathode material. The device consists of two coaxial electrodes with forced cooling, and a magnetic coil surrounding the outer electrode (anode). The coil sets up an axially symmetric flaring magnetic field in the interelectrode space. The end face of the inner electrode (cathode) is made of a vaporizable material (the working substance). Vaporization is produced by the action of moving cathode spots of a vacuum arc struck between the electrodes of the accelerator. The vacuum arc is excited either by breakdown over a batch of gas fed into the gap, or by interruption of the cathode-anode current contact by a moving auxiliary electrode at the anode potential. The proposed device produces focused dense plasma fluxes with particle energy of 100-150 eV from a wide range of solid conductors, including refractories like tungsten, molybdenum, niobium and so on. An accelerator of this type may find application in the development of oilless vacuum systems based on sorption of gases by a condensed plasma flux of getter materials, and in plasma chemistry for high-temperature reactions of various kinds, as well as for studying plasma

properties and making emission sources. The device could also be used to produce
materials and coatings in vacuum by condensation from plasma flows at high and
controllable particle energies. Figures 4, references 6 Russian.
[125-6610]

INVESTIGATION OF ELECTRIC PARAMETERS OF A PULSED PLASMATRON

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[Abstract] An investigation is made of the electrical characteristics of a
plasmatron in a vacuum of $1.33 \cdot 10^{-3}$ Pa. The plasmatron consists of a molybdenum
cylinder with an opening 6 mm in diameter in the bottom. A ceramic washer covers
the opening into which the electrode is inserted. An arc discharge is ignited
inside the cylinder, and the erosion fraction is discharged through the opening
due to the pressure difference inside and outside of the cylinder. The source of
supply of the discharge is a capacitor bank with capacitance of 280 µF charged to
600 V. A pulsed discharge was excited by a low-power spark between a moving thin
tungsten wire and the cathode. The initiating spark was supplied by a capacitor
with capacitance of 0.5 µF. Oscillograms show a discharge current waveshape close
to sinusoidal with amplitude increasing with the source voltage. The slope of the
linear drop in pulse voltage increases with the voltage across the source from 19°
at 200 V to 57° at 600 V. There is no appreciable change in discharge duration
over this voltage range and over a current range of 0.88-2.64 kA. The current-
voltage curves have falling and rising branches with the transition occurring
close to the maximum discharge current. With increasing supply voltage from 200
to 600 V, the discharge energy increases linearly from 0.25 to 1.82 J. The total
percentage of energy in the arc discharge is about 4% of that stored in the
capacitor. Figures 3, references 3 Russian.
[130-6610]

VAPORIZATION OF METALS BY A LASER PULSE AND FORMATION OF A SHIELDING PLASMA LAYER

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[Abstract] The authors study vaporization of Duralumin D16, bismuth, cadmium,
copper and tungsten by Q-switched neodymium laser emission in bell-shaped pulses
with duration of 0.45-0.55 µs at half-power. The beam was irised to keep the
uniformity of intensity distribution within $\pm$ 15%. Total energy on the target
reached 100 J. The experiments were done in a sealed chamber with provisions
for evacuation to 0.1 mm Hg and filling with various gases to a pressure of
30 bars. A piezosensor measured pressure on the target with accuracy of 20-25%.
Time resolution was 20-30 ns. Time dependence of pressure on the surface,
brightness temperatures of the target and plasma and also the coefficients of
reflection were measured simultaneously. The experimental data are compared with
the results of calculations by the theoretical model of "flash" absorption of
laser radiation. Figures 4, references 25: 23 Russian, 2 Western.
[155-6610]

ESCAPE OF WHISTLER WAVES FROM PLASMA WAVEGUIDES

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the Ionosphere and Propagation of Radio Waves

[Abstract] Current theories of waveguide propagation of whistler waves based
on the nonlinear Schrodinger wave equation permit waveguides with either higher
or lower density than in the ambient plasma. However, experiments on strong self-
focusing of whistlers have shown that these waves always propagate in waveguides
with lower density. It is shown in this paper that whistlers always seep out of
waveguides with elevated density, which contradicts the conclusions implied by geo-
metric optics and the Schrodinger equation. Formulas are derived that give a
quantitative description of this leakage effect and provide a natural explanation
for some phenomena that have been experimentally observed. It is shown that tun-
neling processes prevent the containment of whistler waves in high-density plasma
waveguides. The coefficient of attenuation is found for wave damping due to
leakage from the waveguide. It is concluded that a wave with frequency of half
the electronic gyrofrequency or higher cannot propagate in channels with elevated
density, while channels with density lower than the ambient plasma may be ideal
waveguides for frequencies both on this level, lower, and also higher.
Figure 1, references 7 Western.
[149-6610]

EXPERIMENTAL STUDY OF SHOCK WAVES EXCITED IN METALS BY A HIGH-CURRENT
RELATIVISTIC ELECTRON BEAM

DEMIDOV, B. A. and MARTYNOV, A. I.

[Abstract] A high-current relativistic pulsed electron beam is considered as a
model for studying the mechanism of ultrafast impact and crater formation with
explosion close to a surface. Present accelerators can produce a pulsed rela-
tivistic electron beam that yields a power density of more than 10^{12} W/cm^2 in the
focal spot on the anode with self-focusing of the beam. The resultant energy
release in the thin layer determined by the depth of penetration in a pulse as
short as 10^{-7} s leads to thermal explosion of the anode surface. The vapor car-
ries high momentum, giving rise to strong shock waves that cause cratering and
structural changes. The law of spatial attenuation of shock waves in copper and
duralumin anodes is determined on the basis of measurements of shock wave velocity
in the anode along the axis of the electron beam, and maximum pressure in the focal
spot of a relativistic electron beam is calculated. The results are compared with
experimental data on ultrafast impact and with theoretical conclusions. Basic
agreement shows that the proposed model is applicable to many large-scale
cratering phenomena. The authors thank S. S. Batsanov and L. I. Rudakov for
discussion. Figures 3, references 12: 6 Russian, 6 Western.
[110-6610]

SUPERCONDUCTIVITY IN A PERCOLATION STRUCTURE

IOFFE, L. B., Institute of Theoretical Physics imeni L. D. Landau

[Abstract] A theoretical analysis is made of the properties of a chaotic mixture of metallic and dielectric powders far from the superconductive transition point T_c. It is shown that resistance vanishes in such a system at a finite concentration of dielectric $1 - p_c$ in analogy to a phase transition of the second kind. Expressions are found for the shift in T_c close to the threshold of flow as a function of the dielectric concentration, and also for the temperature dependence of magnetization, fluctuation heat capacity and conductivity. Figure 1, references 7: 5 Russian, 2 Western.
[134-6610]

DYNAMIC PROPERTIES OF THIN FILMS NEAR THE SUPERCONDUCTING TRANSITION TEMPERATURE

SVISTUNOV, V. M., D'YACHENKO, A. I., TARENKOV, V. Yu. and STUPAKOV, V. V., Donetsk Physicotechnical Institute, UkSSR Academy of Sciences

[Abstract] A study is done on the resistive state in the vicinity of the superconductive transition of aluminum films sputtered on glass substrates in an oxygen atmosphere at a pressure of about $5 \cdot 10^{-5}$ mm Hg. The films measured 1 x 10 mm in area, and were 250-300 Å thick. The value of dR/dT was measured by the method of modulation of the film temperature below the λ-point in He II. The distance between receiver and source was about 2 cm. The signal from second sound was clearly observable at a source power of 200 μW, constant transport current through the specimen of 100 μA, and frequency of 10 kHz. The conductivity of the films shows an oscillating structure close to the critical point that is attributed to a Berezinskiy-Kosterlitz-Thouless phase transition in the two-dimensional system of weak links formed in granulated microscopically inhomogeneous films. Figures 2, references 3: 1 Russian, 2 Western.
[149-6610]

THEORETICAL PHYSICS

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LYAPUNOV STABILITY OF SCALAR CHARGED SOLITONS

KUMAR, Adzhit, NISICHENKO, V. P. and RYBAKOV, Yu. P., Friendship University imeni Patrice Lumumba

[Abstract] Recently there has been an upsurge of interest in regular localized solutions of nonlinear field equations (solitons) in plasma physics, nonlinear optics, elementary particle theory and other areas. The authors consider the problem of stability of solitons with respect to initial perturbations, and derive stability conditions for charged solitons of pulson type described by a relativistic complex scalar field in a model of general type. The analysis is based on the direct Lyapunov method. It is shown that only conditional stability is possible. Necessary and sufficient conditions of stability of stationary solitons are found for the case of a fixed charge. Examples of models with power-law and logarithmic nonlinearity are examined. References 20: 13 Russian, 1 Polish, 6 Western.
[152-6610]

THERMODYNAMICS

SOLUTION OF THE PROBLEM OF UNSTEADY HEAT CONDUCTION FOR A SANDWICH SYSTEM

APPEN, Ye. P. and OSE, N. L., Power Engineering Physics Institute, LaSSR Academy
of Sciences

[Abstract] The authors consider the problem of heat transfer in a multilayer
system. An analytical solution is found for the problem of unsteady thermal
conductivity for a three-layer system, using the Fourier method. This solution
is used to study the temperatures in a silicon-tungsten-brass system in the
transient mode. The one-dimensional problem is considered with temperature
change in a single direction, modeled by a composite rod. A periodically pulsa-
ting heat flow acts on the base layer of the system at time zero. The lateral
surfaces of the first two parts of the rod, and the end surface of the third
part are thermally insulated, and heat exchange takes place between the surfaces
of the third part of the rod and the ambient atmosphere. The entire system is
initially at room temperature. The results of computer calculations by the pro-
posed method for the silicon-tungsten-brass system are given in the form of graphs
showing the temperature distribution with respect to coordinate for the three
layers at fixed instants of time at different heat exchange coefficients. It
can be seen that the temperature of the system is a periodically increasing func-
tion of time. The differences in heat exchange conditions in the third part of
the rod show up as differences in the temperature curves. Figures 5,
references 5 Russian.
[122-6610]

DEFLAGRATION MODEL OF PULSE ARC IN THE SELF-SIMILAR APPROXIMATION

BOBROV, Yu. K., Kiev Polytechnical Institute

[Abstract] A solution is found for the self-similar problem of the field of gas
flow with dissipation of Joule heat in a pulse arc channel, disregarding intrinsic
magnetic pressure and the pressure of the ambient medium. The stage where the
shock wave front runs ahead of the boundary of the channel is considered. The
absorption of thermally conductive flow on the interface between the plasma and
cool gas is accounted for by the corresponding boundary conditions. The self-
similar law of energy absorbed on the boundary of the channel leads to deviation
from the classical law of deflagration of hot gases although the fundamental
aspects of the process are retained, and the channel boundary can be treated as
a permeable piston. In the limit of absorption of large energy fluxes the problem
reduces to the case of motion of gas displaced by an impermeable cylindrical
piston. The results of calculation of radial and time characteristics of gas
flow are compared with experimental data. Taking the approximation into account,
satisfactory agreement is observed. The author thanks N. I. Fal'kovskiy for
furnishing the experimental material, and also O. S. Il'yenko and Ye. G. Kuz'mina
for doing calculations and discussing the results. Figures 3, references 14 Russian.
[112-6610]

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